



Long Term Resource Monitoring Program

Program Report

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Limnological Monitoring on the Upper Mississippi River System, 1993–1996: Long Term Resource Monitoring Program Onalaska Field Station




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**Limnological Monitoring on the
Upper Mississippi River System, 1993–1996:
Long Term Resource Monitoring Program
Onalaska Field Station**

by

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Preface

The Long Term Resource Monitoring Program (LTRMP) was authorized under the Water Resources Development Act of 1986 (Public Law 99-662) as an element of the U.S. Army Corps of Engineers' Environmental Management Program. The LTRMP is being implemented by the Upper Midwest Environmental Sciences Center, a U.S. Geological Survey science center, in cooperation with the five Upper Mississippi River System (UMRS) States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The U.S. Army Corps of Engineers provides guidance and has overall Program responsibility. The mode of operation and respective roles of the agencies are outlined in a 1988 Memorandum of Agreement.

The UMRS encompasses the commercially navigable reaches of the Upper Mississippi River, as well as the Illinois River and navigable portions of the Kaskaskia, Black, St. Croix, and Minnesota Rivers. Congress has declared the UMRS to be both a nationally significant ecosystem and a nationally significant commercial navigation system. The mission of the LTRMP is to provide decision makers with information for maintaining the UMRS as a sustainable large river ecosystem given its multiple-use character. The long-term goals of the Program are to understand the system, determine resource trends and effects, develop management alternatives, manage information, and develop useful products.

In this report, limnological monitoring by the Onalaska (Wisconsin) Field Station from 1993 to 1996 is summarized. Reports of this type provide a synopsis of the collected data and collection methods, as well as a preliminary report of remarkable or unusual conditions in the system. They are intended to be produced annually.

This report was prepared under Task 2.2.3.6, *Evaluate and Summarize Current Monitoring Results* of the Operating Plan (U.S. Fish and Wildlife Service 1993). This report was developed with funding provided by the Long Term Resource Monitoring Program.

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Abstract: Since 1988, the Long Term Resource Monitoring Program (LTRMP) staff have performed basic limnological field measurements in the Upper Mississippi River System. The period of this report (1993–96) includes a major revision of the LTRMP sampling design in 1993 that added randomization, broader spatial coverage, and increased monitoring of tributaries and locations that allow monitoring of material transport. Personnel from the LTRMP Onalaska (Wisconsin) Field Station made about 1,300 visits to fixed limnological sampling sites and 2,100 visits to stratified random sites in the vicinity of Navigation Pool 8 from 1993 through 1996. An extended, late-season flood in summer 1993 coincided with some of the highest nutrient and lowest dissolved oxygen (DO) concentrations recorded during the report period. Decreases in nutrient concentrations (particularly nitrogen) and increases in water clarity occurred over the 4-year period. Midday DO concentrations were above 5 mg/L throughout most of the year and across most of Pool 8, with localized exceptions during periods of snow cover. Pool 8 and its watershed are a net source of sediment to the Mississippi River; main channel suspended solids concentrations were greater downstream than upstream, and concentrations in the tributaries were typically higher than in the main channel. Strong seasonal patterns were evident for temperature, DO, Secchi transparency, turbidity, total and volatile suspended solids, silicate, chlorophyll *a*, and total phosphorus. Spatial variability (among strata) of most measurements generally increased during lower discharge. Within the individual strata, the pattern of variability could be generalized as follows: isolated backwater > contiguous backwater > impounded ≥ side channel ≥ main channel.

Key words: Annual report, limnology, LTRMP, Mississippi River, water quality

Introduction

The Upper Mississippi River is a major resource of multiple uses that include navigation, water supply, hydroelectric generation, fish and wildlife habitat, and recreation. Effective management of this resource requires scientific understanding of the ecosystem and of its long-term trends and conditions. To meet this need, Congress authorized a Long Term Resource Monitoring Program (LTRMP) for the Upper Mississippi River System (UMRS). The LTRMP, begun in 1988, is intended to provide scientifically sound and useful information by using consistent and reliable methods to monitor and evaluate long-term changes in selected physical, chemical, and biological characteristics.

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The LTRMP water quality staff collects basic information on selected physical and chemical features of the UMRS to aid in the interpretation or prediction of long- and short-term patterns. The data focus on a subset of limnological variables (i.e., physicochemical features, suspended sediment, and major plant nutrients) known to be significant to aquatic habitat in this system. The LTRMP is designed to complement, not replace or duplicate, the monitoring programs of other state and Federal agencies. It therefore includes some limnological characteristics not routinely monitored in water quality programs and it excludes others that are of concern primarily for human consumption or regulatory purposes (e.g., chemical oxygen demand, biochemical oxygen demand, total coliform bacteria, fecal coliform bacteria, fecal streptococcus, heavy metals, pesticides, and polychlorinated biphenyls).

The present report is one in a series summarizing limnological monitoring at each of the LTRMP field stations. This report is intended to (1) document those aspects of sample collection (e.g., sampling times, period of record, sample locations, and allocations among strata) needed for valid interpretation of the data, and (2) report limnological conditions. Detailed analyses and interpretation of the limnological data are reported separately. This report covers multiple years.

To improve readability and increase the usefulness of this document as a reference, the numerous graphic and tabular summaries are included as appendixes. These appendixes are referenced extensively in the main body of the report, and each appendix contains explanatory information that allows it to be used as a nearly independent document.

The data presented here represent a concerted effort by personnel of the Wisconsin Department of Natural Resources and the U.S. Geological Survey who collected, compiled, verified, and organized the data. The specific data used in this report have been archived at the Upper Midwest Environmental Sciences Center (UMESC), La Crosse, Wisconsin (formerly the Environmental Management Technical Center, Onalaska, Wisconsin), and are available on request. This archival step isolates these data from the dynamics (additions and corrections) of the main LTRMP database and thus facilitates the reexamination, reconstruction, or expansion of the results presented here.

The Upper Mississippi River System

The basin of the UMRS (about 490,000 km²) extends from north-central Minnesota to the Ohio River confluence near Cairo, Illinois. The enabling authorization for the LTRMP, however, restricts monitoring to the geological floodplain (about 2% of the total drainage). The LTRMP study areas include selected sections of the Mississippi River (Navigation Pools 4, 8, 13, and 26), La Grange Pool of the Illinois River, and the open river reach (Middle Mississippi River) between the Missouri River and Ohio River confluences (Figure 1).

Field teams of the LTRMP monitor more than 2,000 km of large river; across this expanse there exist distinct differences in climate, geomorphology, surficial geology, and land use. Patterns that arise from the north-south orientation of the system are overlain by upstream to downstream changes related to river size (Vannote et al. 1980). Consequently, the areas monitored by individual field stations differ markedly in the distribution and characteristics of aquatic habitat and aquatic biota. The LTRMP monitoring design must contend with these differences by being flexible enough to accommodate local conditions but appropriately uniform across all study areas to permit comparison and synthesis.



Figure 1. The Long Term Resource Monitoring Program (LTRMP) study area. Although the Missouri River is shown for reference, only the mouth of this tributary is sampled for water quality under the LTRMP.

Dam construction on the Upper Mississippi and Illinois Rivers has profoundly altered these rivers, creating a series of rapidly flushed impoundments connected by short stretches of flowing river that are influenced by dam operations (Figure 2).

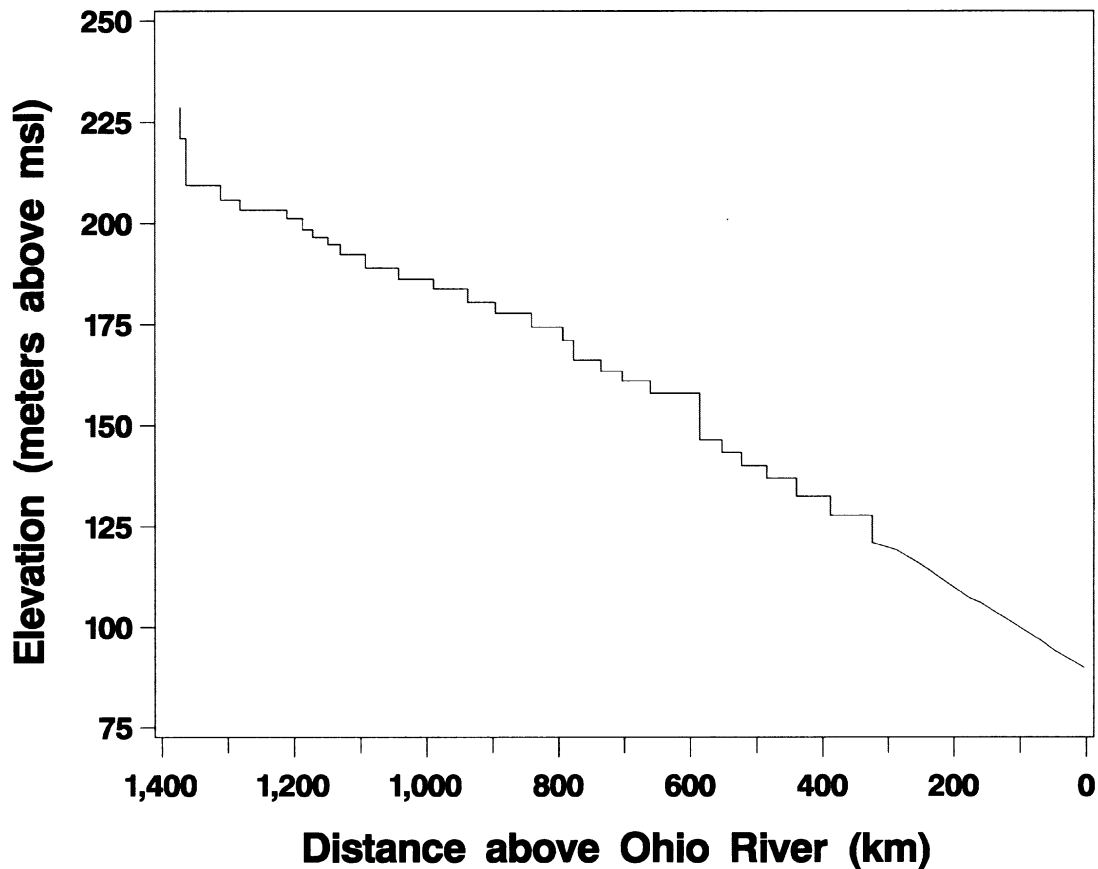


Figure 2. Water surface elevation (meters above mean sea level) of the Mississippi River from the head of navigation near St. Paul, Minnesota, to the confluence of the Ohio River near Cairo, Illinois.

The dams on the main stem of the Upper Mississippi River are numbered from upstream to downstream (starting near St. Paul, Minnesota), and the river reach above each dam is called a pool (Table 1a). The pool has the same numeric designation as the downstream dam. For example, Pool 14, near Clinton, Iowa, includes the entire reach of river upstream of Lock and Dam 14 and downstream of Lock and Dam 13. A similar system is used on the Illinois River, but the individual dams are named rather than numbered (Table 1b). Although the navigation dams have created significant zones of permanent inundation in Pools 1–13 of the Upper Mississippi River, these zones are usually less than half the total water surface within the pool (LTRMP aquatic areas database) and are semifluvial (average hydraulic residence times <2 days). Between Pools 13 and 26 in the Mississippi River and in most of the Illinois River, the navigation dams have deepened the river and widened it slightly, but have permanently inundated little terrestrial area compared with major river impoundments and have created minimal lake-like habitat. The term pool is therefore misleading inasmuch as it suggests that the UMRS is a stair-step series of lake-like impoundments. Nonetheless, the term is widely used and recognized by those familiar with the UMRS and it is used freely in this report.

The first major dam on the Upper Mississippi River was constructed in 1913 near Keokuk, Iowa, and was followed by 27 additional dams on the main stem to create a 2.7-m (9-foot) navigational waterway from Alton, Illinois, to St. Anthony Falls near St. Paul, Minnesota. Twenty-two dams were built between 1935 and 1940; the last dam was completed in 1958 at Lower St. Anthony Falls near Minneapolis (Table 1a). The navigation system was altered significantly in 1993 when Lock and Dam 26 at Alton was replaced by a new structure (Melvin Price Locks and Dam) with increased lock capacity about 1.6 km (1 mile) farther downstream. The previous Lock and Dam 26 was removed after the new structure was completed.

Table 1a. Dams on the Upper Mississippi River.

Name of dam	Date placed in service	City	River mile	Drainage area (km ²)	Dam height (m)	Pool elevation (feet)
Lower St. Anthony Falls	11/13/1958	Minneapolis, Minnesota	853.2	51,000	7.3	750.0
1	07/03/1917	St. Paul, Minnesota	847.6	51,000	11.3	725.1
2	07/01/1931	Hastings, Minnesota	815.2	96,000	3.7	687.2
3	07/21/1938	Red Wing, Minnesota	796.9	117,000	3.7	675.0
4	05/25/1935	Alma, Wisconsin	752.8	148,000	2.4	667.0
5	05/29/1935	Minneiska, Minnesota	738.1	152,000	2.1	660.0
5a	07/06/1936	Winona, Minnesota	728.5	153,000	2.7	651.0
6	06/30/1936	Trempealeau, Wisconsin	714.3	155,000	1.7	645.0
7	04/19/1937	Dresbach, Minnesota	702.5	161,000	2.0	639.0
8	04/26/1937	Genoa, Wisconsin	679.2	168,000	2.4	631.0
9	07/08/1937	Lynxville, Wisconsin	647.9	172,000	3.4	620.0
10	11/26/1937	Guttenberg, Iowa	615.1	206,000	2.7	611.0
11	09/14/1937	Dubuque, Iowa	583.0	211,000	2.4	603.0
12	05/14/1939	Bellevue, Iowa	556.7	213,000	3.4	592.0
13	05/13/1939	Clinton, Iowa	522.5	221,000	2.7	583.0
14	06/14/1939	Le Claire, Iowa	493.3	229,000	3.3	571.9
15	03/07/1934	Rock Island, Illinois	482.9	229,000	4.9	561.0
16	07/10/1937	Muscatine, Iowa	457.2	257,000	2.7	545.0
17	05/14/1939	New Boston, Illinois	437.1	258,000	2.4	536.0
18	09/08/1937	Burlington, Iowa	410.5	294,000	3.0	528.0
19	06/12/1913	Keokuk, Iowa	364.2	308,000	11.6	518.2
20	06/09/1936	Canton, Missouri	343.2	348,000	3.0	480.4
21	07/21/1938	Quincy, Illinois	324.9	348,000	3.2	470.0
22	07/22/1938	Saverton, Missouri	301.2	356,000	3.1	459.5
23 ^a	—	—	—	—	—	—
24	1940	Clarksville, Missouri	273.4	365,000	4.6	449.2
25	05/18/1939	Cap Au Gris, Missouri	241.4	368,000	4.6	434.9
26 ^b	05/01/1938	Alton, Illinois	202.9	443,000	6.7	419.0
Melvin Price	1990–1994	Alton, Illinois	200.8	444,000	7.3	419.0

^aLock and Dam 23 was never built.

^bLock and Dam 26 was removed after the Melvin Price Dam was placed in service.

The history of impoundment on the Illinois River is similar to that of the Upper Mississippi River, and the Illinois River is now divided into six navigational pools (Table 1b). The first dams were completed on the upper portions of the Illinois River (Starved Rock, Marseilles, and Dresden Island) in 1933; additional dams at Peoria and La Grange were completed in 1938. The Melvin Price Locks and Dam on the Mississippi River near Alton, Illinois, also impounds the lowermost portion of the Illinois River.

Table 1b. Dams on the Illinois River.

Name of dam	Date placed in service	River mile	Drainage area (km²)	Dam height (m)	Pool elevation (feet)
Thomas J. O'Brien ^a	1960	326.5	0	1.2	583.5
Lockport	1933	291.1	1,900	12.3	579.5
Brandon Road	1933	286.0	3,900	10.4	539.0
Dresden Island	1933	271.5	18,800	6.7	505.0
Marseilles	1933	247.0	21,400	7.3	483.0
Starved Rock	1933	231.0	28,600	5.8	459.0
Peoria	1938	157.7	37,700	3.4	440.0
La Grange	1939	80.2	66,400	2.9	429.0

^aThis structure controls diversion discharge into the Illinois waterway from outside the drainage basin (Lake Michigan).

Methods

Study Area

The study area of the LTRMP includes the Mississippi River from Cairo, Illinois, to the head of navigation near St. Paul, Minnesota; the Illinois River; and navigable portions of the Kaskaskia, Black, and St. Croix Rivers. In recognition of the highly variable and widely differing river characteristics within this large study area, the Comprehensive Master Plan (Jackson et al. 1981) recommended 17 pools or reaches for detailed monitoring. Available resources, however, have limited the LTRMP to six selected areas, and the five states bordering the Upper Mississippi River now operate six LTRMP field stations that focus on these specific reaches. These areas (Figure 1) are concentrated in the uppermost segments of the Mississippi River. The river sections presently monitored under LTRMP for water quality include Pools 4, 8, 9, 12, 13, 14, and 26 in the impounded portion of the Upper Mississippi River; 80 miles of the open river above the Ohio River confluence at Cairo, Illinois; and La Grange Pool of the Illinois River. All of the major tributaries of the Mississippi and Illinois Rivers in these river segments are monitored under the LTRMP. The long (400 km) reach of the Upper Mississippi River between Pools 14 and 26 is not monitored under the LTRMP, but other state and Federal programs collect water quality information in this reach and adjoining tributaries (i.e., Iowa-Cedar, Rock, and Des Moines Rivers).

The Wisconsin Department of Natural Resources (WDNR) field station is located at the UMESC in Onalaska, Wisconsin. Field station staff conduct LTRMP monitoring within Pool 8, as well as adjacent portions of the River and its tributaries (Figure A-1, Table A-1). Water quality monitoring has been conducted in the Pool 8 vicinity by the WDNR field office staff since 1988 (Appendixes A and B).

The Pool and its tributary watersheds lie within the driftless—or unglaciated—area, referred to locally as the Coulee Region. It is defined by Lock and Dam 8 at Mississippi River mile 679.2 and Lock and Dam

7 at Mississippi River mile 702.5, is about 37 km (23.3 miles) long, and is oriented roughly north–south. It has complex braid-anastomosed channel morphometry with extensive off-channel aquatic areas that provide diverse habitat for both aquatic and terrestrial biota, as well as numerous recreational opportunities.

The La Crosse, Wisconsin, metropolitan area, with a population of about 120,000, lies in direct proximity to the upper third of Pool 8. Urban development, stormwater runoff, and sewage treatment effluent probably affect habitat and water quality in Pool 8. In addition to storm sewers, there are many other point source discharges that empty either directly or indirectly into Pool 8, including about 15 industrial dischargers and five municipal wastewater treatment plants. The city of La Crosse operates two wastewater treatment plants that discharge directly to the Mississippi River at about river miles 696.8 and 697.8. Two wastewater treatment plants discharge to isolated backwaters of Pool 8. The La Crescent, Minnesota, wastewater treatment plant discharges to Blue Lake (river miles 698–699), and Stoddard, Wisconsin, wastewater treatment plant discharges to a small isolated backwater near the confluence of Coon Creek (river mile 684.5). At normal water elevations, these isolated backwaters have little or no connection to the main channel of Pool 8. The fifth wastewater treatment plant at Genoa, Wisconsin, has the lowest design flow and discharges to the main channel at river mile 679.7.

Two tributaries, the Root and La Crosse Rivers, enter the Mississippi River at river miles 693.7 and 698.2, respectively. The Root River flows through southeastern Minnesota, an area of intense agricultural activity. After storms and spring runoff, marked turbidity differences are often apparent between the Root River inflow and the Mississippi River for several miles downstream. The La Crosse River transitions from a trout stream in its upper portions to a watershed containing agriculture, swamps, marsh, and bogs in the middle and lower portions. Problems with high sediment concentrations, low dissolved oxygen (DO), and high ammonia concentrations have been documented in the La Crosse River, resulting in a strong recommendation for selection as a Wisconsin Priority Watershed (WDNR 1994). Both the Root and La Crosse Rivers are monitored at their confluence with the Mississippi River by personnel of the Onalaska (Wisconsin) Field Station.

The Onalaska Field Station Water Quality team also monitors the main stem of the Black River at Lytle's Landing (before it enters Lake Onalaska) and the old Black River channel 1.6 km (1 mile) upstream of the confluence with Pool 8. Although it is still identified as the Black River, the old Black River channel became part of the impoundment after the Locks and Dams were established. It flows through Lake Onalaska in Pool 7, over a spillway at Onalaska (about river mile 703.5), and enters Pool 8 at river mile 699. Although the water entering Pool 8 retains much of its original character, it mixes somewhat with the Mississippi River in Lake Onalaska and differs slightly from the Black River proper. Land cover in the Black River watershed is primarily woodland (52%), followed by cropland (31%), grassland (12%), miscellaneous (4%), and urban (<1%). The upper and central portion of the watershed is glacial deposit, with soils ranging from silty loam in the north to sandy in the central portion. The lower portion of the watershed is unglaciated with primarily sandy soils; as of 1980. Nineteen wastewater treatment plants discharge to streams and rivers within the Black River basin (WDNR 1980). A national Superfund site, where groundwater is air-stripped of volatile organic compounds and discharged to the Black River, is located immediately downstream of the Lytle's Landing monitoring station (BK14.2M, Figure A-1).

Several other tributaries to the Mississippi River are also monitored by the Onalaska Field Station team. Coon Creek (Wisconsin) is sampled 1 km (0.6 miles) upstream of the confluence with the Mississippi River, at Mississippi River mile 684.5. The Coon Creek watershed, a small tributary to Pool 8, has been recommended as a high priority watershed project (WDNR 1994), in part because of its effect on the Mississippi River receiving water. The Bad Axe River, a Wisconsin tributary to Pool 9, and the Upper Iowa

























River, an Iowa tributary to Pool 9, are also routinely sampled by the Onalaska Field Station Water Quality team.

Declines in aquatic vegetation have been documented in Pool 8, particularly *Vallisneria americana* in the lower pool (Fischer and Claflin 1995), just as similar declines have been documented in other pools of the Mississippi River (Rogers 1994). Recent changes in the aquatic vegetation communities are important to the evaluation of water quality data because of the profound affect that macrophytes can have on temperature, DO, pH, underwater light, and nutrients (Wetzel 1983). Although reasons for the declines are largely unknown, physical changes in habitat (i.e., island erosion and sedimentation of backwaters) may explain some of the losses; about 70% of the islands in Lower Pool 8 have been lost to erosion since impoundment (unpublished UMESC geospatial data). Informal survey data collected for the LTRMP suggest that some recovery has occurred in certain submersed vegetation communities of Pool 8 during recent years (Heidi Langrehr, personal communication).

Monitoring Network and Sampling Design

The LTRMP was begun in 1988; field stations were added to the network from 1988 to 1991 (Table 2). This staggered start is significant when making comparisons among study areas or assessing overall trends across the system. Limnological monitoring during the first years (1988–91) was limited to fixed sites and to in situ physical and chemical measurements. The present LTRMP sampling design (implemented in June 1993) includes both fixed-site (Appendix A) and stratified random sampling (SRS; Appendix B) and combines in situ field measurements with laboratory analyses of chemical constituents (Appendix C).

Table 2. Period of operation for each of the Long Term Resource Monitoring Program field stations.

Field station	1988	1989	1990	1991	1992–1996
Lake City			Jan 		
Onalaska	Jul 				
Bellevue	Aug 				
Pool 26	Jul 				
Open River				Mar 	
Havana		Sept 			

Fixed-site sampling in the present design monitors inflows (tributaries and dam releases) and outflows from each of the LTRMP study areas. Secondly, fixed sites are used to monitor locations of special significance, either because of their long data record or some other feature that makes them notable or especially interesting. Each LTRMP field station monitors about 15–30 fixed sites biweekly with no attempt to capture or avoid high or low flows (Appendix A).

From 1988 to 1993, the LTRMP used 24 aquatic habitat classes (Appendix A) to describe the permanently fixed monitoring sites. Some of these classes included a seasonally varying attribute (aquatic vegetation) as part of their definition, and the classes were not mutually exclusive. For example, a site in midchannel downstream of a dam might be classified as “Main Channel” (MC), “Channel Trough” (CTR), “Open Tailwater” (TWR-O), or “Tailwater” (TW). This classification scheme was revised in 1993 when vegetation

status was dropped from the habitat designators and those categories that were viewed as redundant or not distinguishable by routine water quality measurements were eliminated. The revised system has seven habitat classes (Table A-4), and all previous habitat classifications for fixed sites were converted to this system. The original designations for all fixed sites are permanently on file at UMESC and at the individual field stations.

As with the six field stations, the period of record differs among individual fixed sites. When the emphasis of fixed-site sampling shifted to tributaries and other transport monitoring points in 1993, sites were added and eliminated from the sampling network in each study reach. At the same time, sampling frequency at fixed sites was reduced from weekly to biweekly (Figure A-2) to keep the overall level of monitoring constant despite the addition of SRS.

The habitat class associated with each fixed site provides useful ancillary information about the site and a convenient way to retrieve data from the LTRMP database. However, LTRMP fixed-site data cannot be used generally to make inferences about these habitat classes because fixed sites were chosen subjectively and without randomization and represent only specific locations. Although the sampling sites can be grouped by their habitat categories, the resultant groupings are not unbiased samples of these categories. To overcome this limitation, the monitoring design was modified in 1993 to include SRS and thus provide unbiased information about broad spatial areas.

The LTRMP design for fixed-site sampling requires that each day's sampling effort be centered on noon (1200 h), central standard time, and that the order of site visits within each sampling day be randomized to the extent feasible within operational constraints. This sampling schedule was formally established in September 1993.

The SRS complements the fixed-site design and provides a seasonal assessment of known precision and confidence on limnological conditions in broad sampling strata in the LTRMP study areas. Limnological data from SRS are intended to be linked to patterns in fish, vegetation, and invertebrates at the spatial scale of a whole navigational pool or river reach and at temporal scales ranging from seasons to decades. The SRS data can be interpreted confidently at these scales of space and time. Higher resolution questions (e.g., short-term movements or locations of fish, growth dynamics within individual aquatic plant beds) are outside the realm of routine monitoring as defined by the LTRMP and are not addressed by SRS or fixed-site sampling in the LTRMP monitoring design.

The SRS is performed in four quarterly episodes each year (Appendix B). In each SRS episode, about 150 sites are randomly selected from six sampling strata, and sampling is completed usually within 14 days (Appendix B). The sampling strata are condensed from the geomorphic "aquatic areas" of Wilcox (1993) and are objectively defined in a geographic information system (Owens and Ruhser 1996). Specific sampling points for each sampling episode are selected by overlaying a square grid with 200-m spacing on a map of the sampling strata. Grid intersections are randomly selected for each sampling episode. Beginning in spring 1995, a 50-m grid was used for side channel and backwater strata. A smaller grid spacing was deemed appropriate to the spatially diverse conditions within these strata (i.e., points 50 m apart are likely to be different); this increases the number of potential sites available for site selection. Although the number of sites selected was not altered by this change in grid spacing, the number of locations resampled in subsequent episodes was greatly reduced. The allocation of samples among strata emphasizes off-channel areas and is not proportional to the surface area of the strata (Appendix B). Data from the strata must be weighted to obtain accurate poolwide or reachwide estimates, and this weighting must account for the areas of the strata, the differing grid intervals among the strata, changes to the grid in 1995, and the allocation of sampling effort (Appendix B).

The LTRMP design for SRS requires that each day's sampling be centered on 1200 h, central standard time, and that the order of site visits within each sampling day be randomized to the extent feasible within operational constraints. This specification for sampling times was formally established in September 1993.

The sampling strata used by the LTRMP are primarily a statistical tool that allows the spatial allocation of sampling effort to match differences in desired precision and variability among the strata. An exact correspondence between sampling strata and the aquatic areas of Wilcox (1993) is not attainable and is not required by the LTRMP statistical design. The data from a sampling stratum, therefore, should not be regarded as precisely representing a specific aquatic area type.

Because the river is dynamic, the borders of the aquatic areas change over time, but the sampling strata boundaries have been (with minor exceptions) static since their original designation in 1993. Thus, the aquatic areas are expected to gradually diverge from the sampling strata because of long-term changes in river morphology. In addition, short-term fluctuations in water level can make sites unusable or atypical of their parent stratum. The field teams use data comments to report sites that cannot be sampled or seem to be outside their designated sampling stratum. These comments are extremely valuable for data interpretation and also give a rough indication of the rate or extent of divergence between the sampling strata and the aquatic areas. However, field comments lack the spatial intensity and consistency required for tracking or mapping changes in stratum boundaries, and the LTRMP staff intends to track changes in aquatic areas by systemwide remapping and reclassification of areas at regular (e.g., 10-year) intervals. If future remapping results in new sampling strata, all sampling locations will have both pre- and postrevision stratum codes assigned. This will allow analysis for the full period of monitoring to be based on either mapping scheme.

The capacity of the LTRMP analytical laboratory has restricted the number of chemical measurements performed on SRS samples. Consequently, from 1993 to 1996, SRS has included major plant nutrients, suspended solids, and phytopigments, but has excluded major cations (sodium, magnesium, calcium, potassium) and major anions (chloride and sulfate). In situ measurements are made at all SRS sites; to reduce the laboratory sample load, however, samples are collected for a full complement of laboratory analyses only in a randomly selected subset (about half) of sites. Significant improvements in laboratory performance in 1997 may reduce these limitations in future years.

Sample Collection

The LTRMP limnological monitoring includes measurements at multiple depths (Soballe and Fischer 2003). About 80% of LTRMP measurements from 1993 to 1996 were taken near the water surface (0.0 to 0.2 m); laboratory analyses during this period were performed only on near-surface and near-bottom samples. The LTRMP sampling for water quality is generally restricted to waters 0.2 m deep or deeper. However, samples are occasionally collected in shallower waters, particularly under ice cover, when they can be taken without disturbing the substrate. Discrete, rather than integrated, samples are collected and analyzed. Grabs for chemical analyses are taken with either a bucket (near surface) or a Van Dorn-type sampler (at depth).

When the sampling design was revised in 1993, grab-sampling techniques remained unchanged; however, individual instruments used to monitor pH, conductivity, temperature, and DO were replaced by a multiparameter monitoring device used for in situ measurement and recording. The LTRMP Procedures Manual (Soballe and Fischer 2003) provides additional details.

Ice cover can vary widely in extent and thickness across the study area, complicating sample collection and the recording of sample information. It is not meaningful, for example, to report limnological conditions

at 0.2 m below the water surface when the ice extends below this depth, nor to report maximum water depth when ice extends into the substrate. Consequently, when ice is present, LTRMP crews collect near-surface samples at 0.2 m below the bottom of the ice (where possible). The reported sampling depth in this situation (0.2 m) must be adjusted for the vertical extent of ice below the water surface (also recorded) to determine the actual vertical location of the sample in reference to the free water surface. In this report, we summarize the data by depth sampling category rather than precise vertical location, and the sampling depths have not been adjusted for the vertical extent of ice below the water surface. In addition, sites that were frozen to the substrate have been excluded from the summaries of water depth.

Laboratory Analyses

The LTRMP added a limited suite of laboratory analyses to the limnological monitoring in 1991 and expanded the list of chemical constituents in 1993 (Appendix C). From 1991 to 1993, samples for chemical analyses were collected biweekly during the ice-free period; this frequency was reduced to monthly in winter. Also during this period, chemical analyses were performed at the Waterways Experiment Station (WES) laboratories at Vicksburg, Mississippi, and the U.S. Army Corps of Engineers Eau Galle laboratory near Spring Valley, Wisconsin. In 1993, analysis of LTRMP limnological samples was gradually shifted to the UMESC in La Crosse, Wisconsin (Table C-2).

In late summer and fall 1996, the UMESC analytical laboratory experienced contamination of the equipment used for total phosphorus analyses. The source of the problem was eventually identified and eliminated in December 1996; those analytical results affected by this contamination have been excluded from this report and are identified in the LTRMP database. The laboratory also experienced ammonia contamination of the equipment in May 1996, which invalidated many of the ammonium samples collected in the spring 1996 SRS episode. Those data have also been excluded from this report. Detailed descriptions of the methods used by the UMESC and WES laboratories are available on request from the UMESC in La Crosse, Wisconsin.

Quality Assurance and Quality Control Procedures

The value of LTRMP data depends on their quality and reliability. The use of standard methods to assure and control the quality of the data are thus extremely important. The original LTRMP procedures (Lubinski and Rasmussen 1988) gave guidance on instrument calibration, record keeping, data management, and organizational relations. Revisions to the procedures (Soballe and Fischer 2003) provided details on assessing the accuracy and precision of field measurements and also addressed issues (i.e., daily and seasonal sampling windows, randomization of sampling sites and times) related to the conduct of field work. Guidelines for the time of sampling and randomization of sampling order were implemented in 1993, and compliance with these guidelines is reported here (Appendix D).

The LTRMP field teams began collecting additional Quality Assurance and Quality Control (QA/QC) measurements and samples near the end of April 1995 to assess the accuracy and precision of both laboratory and field measurements. The QA/QC sampling data are readily available (http://www.umesc.usgs.gov/data_library/water_quality/water_quality_page.html), but not summarized here.

Following the recommendations of APHA (1992), at least 5% of each type of chemical or physical measurement collected by an LTRMP water quality team is accompanied by a series of QA/QC measurements, and each sampling crew is required to perform at least one QA/QC series during each day

of field work. The daily crew requirement results in about 15% of all samples being accompanied by QA/QC measurements, exceeding the APHA recommendation and LTRMP minimum requirement. Because of logistic constraints, the LTRMP did not use field spikes (additions of known concentrations of chemical constituents) in 1993–96, but did collect four types of QA/QC samples:

Routine: The regular or routine sample or measurement taken at the site.

Field Split: A field sample that is as similar as possible to the routine sample at the point of collection. It is used to evaluate laboratory precision and variability introduced by field handling or processing. Field splits are performed for all the constituents listed in Table C-2 that are presently analyzed.

Blank: A sample used to check for contamination of the analytical water supply or sample containers, or contamination and losses during handling and storage. It is also used to evaluate precision at concentrations near the detection limit.

Replicate: A second, separate sample taken at the same location and in the same way as the routine, but separated by an interval of 5–10 minutes. This provides information on natural, random background variability in ambient conditions.

Results

River Discharge Regime

River discharge (flow) is a major factor in the ecological and limnological structure and functioning of the UMRS. Flow strongly influences limnological conditions and, thus, the interpretation of the monitoring data must consider the hydrologic setting (flow regime) under which the data were collected. Because river discharge is so important, staff of the LTRMP have assembled the Mississippi and Illinois Rivers discharge and surface elevation data collected by the U.S. Geological Survey and the U.S. Army Corps of Engineers into a database at the UMESC (Wlosinski et al. 1995). The discharge and water elevation data used in this report were obtained from that database.

Water levels at the Lock and Dam 7 tailwater gage (Figure 3) indicate the general hydrologic regime in the Pool 8 study area. Flood stage at this gage is 194.65 m (638.6 feet) above mean sea level. The U.S. Army Corps of Engineers water elevation data were obtained from the UMESC (Wlosinski et al. 1995).

Water levels at this site reflected the large, spring and summer flood of 1993 and indicate that water levels during the entire reporting period were generally above the 56-year average but were usually below flood stage. The flood of 1993 was notable for high water levels, but more remarkable for its duration (nearly the entire summer) in this area. Flood stage was also exceeded in spring 1994 and 1996, but not to the same extent as in summer 1993.

The limnological data collected in 1993–96 reflect the hydrologic conditions at the time of collection; for example, water levels in fall were above average during 3 of these 4 years. Water levels during winter SRS in 1996 were above normal, whereas those in winters 1994 and 1995 were about average. The spring maximum in water level typically occurs in mid-April every year, about one week before the spring SRS, therefore these data reflect conditions during the crest and decline of the spring flood for all years. Water levels during the summer SRS episodes were about average (with the exception of 1993; Figure 3). Results of the fixed-site limnological monitoring also reflect above normal water levels in most years.

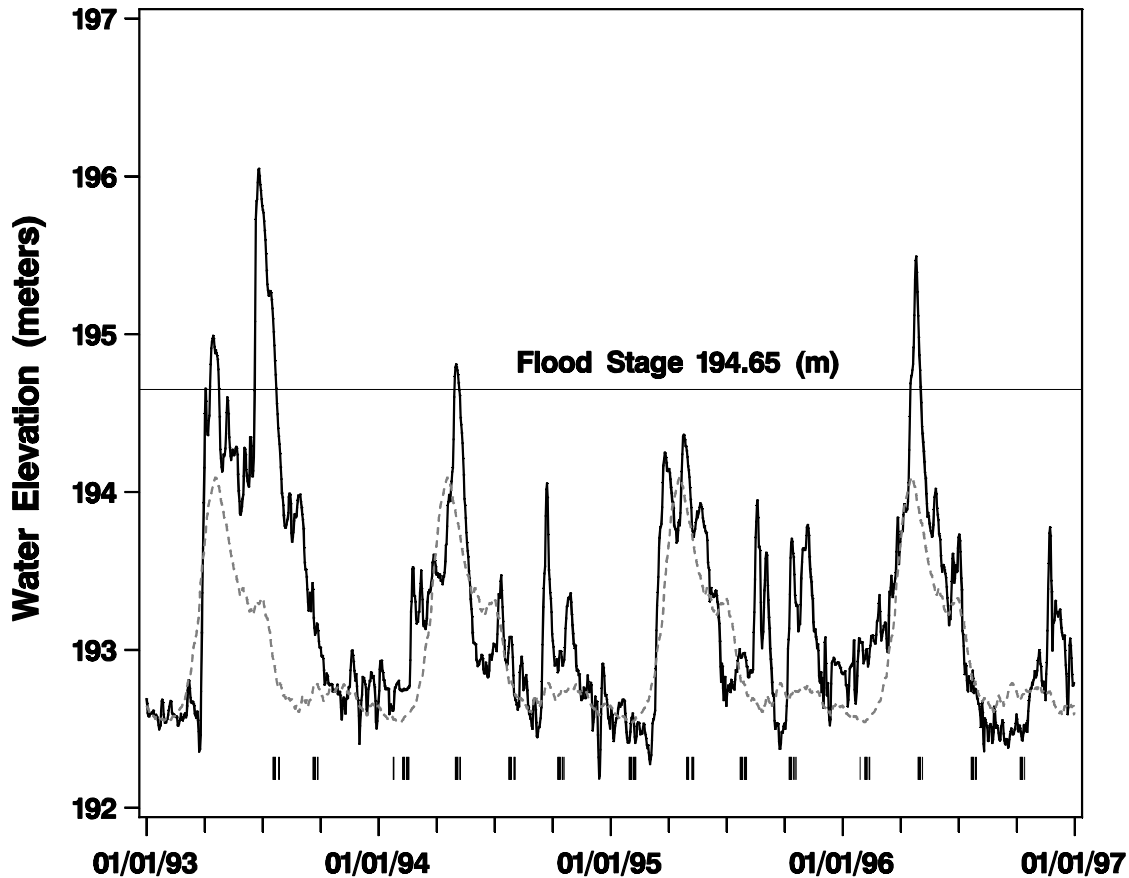


Figure 3. Water elevation (meters above mean sea level) at Lock and Dam 7 Tailwater from 1993 through 1996 (*solid line*) and the 1940–1996 average annual hydrograph (*dashed line*). Vertical lines above the horizontal axis indicate dates of stratified random sampling. Water elevation for flood stage is indicated by the horizontal line.

Fixed-site Sampling

Sample Collection and Field Measurements

The volume of field work completed by each field station is important to document for planning and budgetary purposes. The schedule of sample collection is also important to document because many of the limnological characteristics monitored by the LTRMP exhibit regular daily (diel) patterns. The time of measurement can thus strongly influence the value that is observed and, because the LTRMP strives to monitor patterns over time across the UMRS, it is important that sampling times remain consistent and unbiased with regard to location over the duration of the program, among sampling locations, and among field stations.

From 1993 through 1996, the water quality team from the Onalaska Field Station made about 1,300 site visits to fixed sampling locations (Appendix D). During these visits, about 1,100 grab samples were collected for chemical processing (Appendix E).

The number of site visits during a week of sampling was typically 11 immediately after the 1993 redesign. Two more tributary sites (the Upper Iowa and Bad Axe Rivers) were added to the routine fixed sites in July 1995, bringing the total to 13 (Figure D-1 and Table D-1). Before the redesign of sampling in 1993, the number of weekly fixed-site visits varied because some sites were sampled weekly and others less frequently. Additionally, if scheduled sites were missed, they were often sampled during off-weeks, thereby making the number of weekly site visits inconsistent. Sites were occasionally missed because of inaccessibility associated with time of year and unsafe conditions (e.g., unacceptable ice conditions, deep snow, extreme cold) and, to a lesser extent, equipment malfunctions and lack of personnel. The purchase of an airboat in 1995 considerably reduced the accessibility problems (Figure D-1) that were common when the crews relied solely on a hovercraft for winter transportation. Time and logistical constraints during SRS episodes sometimes prevented sampling the fixed sites as scheduled, so they were often sampled while in proximity to SRS sites (not necessarily on the same day or even the same week). Nearly all deviations shown in Figure D-1 were due to sampling sites during an off-week, as opposed to missing them completely (Table D-1).

The distribution of sampling across the hours of the day (Figures D-2–D-4) reflects the September 1993 change in the fixed-site sampling protocol. In the early months of 1993, sampling was conducted earlier in the day (median = 1140 h) and showed a somewhat broad distribution. The sampling window was more closely (and formally) defined in 1993, and subsequently the median sampling time moved later (Figure D-2) and was more nearly centered on 1200 h. Sampling times were generally within design specifications. The sampling window was quite broad (but within limits) and there was a tendency to sample more sites in the afternoon. There was also a minor, but significant, linear increase in sampling time at the fixed sites ($P < 0.001$) from 1993 to 1996 (about 3 minutes per year). Most of this trend is due to the initial adjustment to the new sampling window in September 1993; after this date the increase is not statistically significant ($P = 0.09$). The distribution of fixed-site sampling times across the period of record (Figure D-3) shows a distinct seasonal pattern, with later sampling in winter.

The distribution of median sampling times for sites (Figure D-4) is parallel to that for samples (Figure D-2). In 1993, the median sampling time varied substantially among sites (Figure D-4), and more sites were sampled in the morning than afternoon. After noon-centered sampling was implemented in 1993, the median site visit times in 1994 and 1995 were more tightly grouped and shifted sharply to afternoon (Figure D-2). Reasons for the shift are unclear, and efforts were made to bring more of the sites closer to a 1200 h median. By 1996, the distribution of sample collection times had a median of 1214 h.

Fixed-site Sampling Data

Fixed-site sampling by the Onalaska Field Station from 1993 to 1996 has generated a large volume of data (Appendix E). These data allow comparisons of tributary and main-stem inflows and outflows within this study area and thus provide information on sources of material such as nutrients and suspended sediment and the functioning of the study reach as a processor of those materials.

The fixed-site data reveal important functional aspects of this reach of the river. For example, the data suggest a long-term decline in the concentrations of total and nitrate–nitrite nitrogen as well as total and soluble reactive phosphorus (Figure E-2a). When coupled with a steady to declining flow regime (Figure 3), this suggests a significant decline in the transport of these materials in this reach during the study period; detailed loading calculations are needed to verify this apparent trend. Overall, trends in the tributaries were similar to those of the main channel, where declines were also observed during the study period in some nutrient concentrations.

Although some enrichment is evident, generally only minor increases occurred in some nutrient concentrations upstream to downstream in Pool 8, and the greatest increase was generally in nitrogen (nitrate–nitrite and total nitrogen) concentration. Although the trends were similar, the concentrations of nitrate–nitrite in the Root River were about 1–2 mg/L higher than the main channel, and about 1–4 mg/L higher than the La Crosse and Black Rivers. Greater concentrations in the Root River, coupled with slightly higher nitrate–nitrite concentrations in the downstream reach of Pool 8, suggest enrichment largely from the Root River. Conversely, there tended to be little difference in upstream–downstream total phosphorus concentrations. Soluble reactive phosphorus (and to a lesser extent, silicate and ammonium) tended to be lower in the downstream reach, suggesting assimilation by phytoplankton or macrophytes. The higher concentrations of chlorophyll *a* and DO in the lower reach also support this hypothesis. Nitrification may account for downstream declines in ammonium concentration.

Contrary to longitudinal nutrient concentrations, turbidity and suspended solids increased substantially from upstream to downstream (Figures E-1a and E-2a), suggesting that this reach (and its adjacent watershed) is a significant source of sediment. The Root River, where the mean concentration of suspended solids was 3 to 4 times that of the main channel, and turbidity was more than double in some years, is probably one source of this material. In addition to the Root River influence, the data suggest that other tributaries may also have an effect. For example, Coon Creek had mean turbidity levels 3 times and suspended sediment concentrations 4 to 5 times the main channel concentration. Suspended solids concentrations in the La Crosse River were more than double those of the main channel. Additionally, suspended solids concentrations were much more variable in the tributaries than in the main channel, probably because of the event-driven nature of smaller rivers. The upstream–downstream differences coupled with greater suspended solids concentrations in the tributaries suggest that Pool 8 and its watershed are acting as a sediment source.

The fixed-site data show the strong seasonality of flow-related parameters (e.g., turbidity, Secchi transparency, suspended solids, and total phosphorus) in Pool 8 and its tributaries (Appendix E). Lack of allochthonous input and elimination of wind-driven resuspension probably accounted for increased transparency in winter, when suspended solids and turbidity were lowest. Nitrate and ammonium concentrations peaked in the tributaries in late winter and early spring (most likely associated with the spring thaw), although the patterns in the Root River and main channel were considerably less distinct than at other sites. Ammonium concentrations typically showed strong spring increases (with the exception of spring 1995) at all sites, followed by generally lower concentrations throughout summer. Main channel soluble reactive phosphorus and silica concentrations were usually lowest during May–June when chlorophyll *a* concentrations were high, consistent with maximal diatom growth in late spring (Figures E-2a–E-2d). Total phosphorus concentrations were usually lowest in winter, then peaked in spring and late summer. Conversely, silicate concentrations were lowest in early summer, then gradually increased to a peak in winter. Although seasonal patterns for all constituents are apparent in both the main channel and the tributaries, they are generally less distinct in the main channel.

The DO saturation is a function of water temperature and thus shows strong seasonality at all sites. Monthly means do not reveal extremes in DO, and the LTRMP sampling schedule (centered on 1200 h) does not give a good representation of low (expected near sunrise) or high (expected in mid- or late afternoon) oxygen concentrations. Oxygen concentrations frequently decline after heavy rain, and some of the lowest DO readings were recorded during 1993 flooding. Concentrations at the fixed sites were usually near saturation on a year-round basis, with backwaters occasionally reaching supersaturated conditions. In addition to seasonal fluctuation, DO and temperature in some backwaters of Pool 8 are strongly influenced by changes in river elevation (Fischer et al. 1997).

Stratified Random Sampling

Sample Collection and Field Measurements

As in fixed-site sampling, the number and frequency of samples collected and the scheduling of sample collection in SRS is important for planning and data interpretation. Sample collection in SRS must be consistent and unbiased over time, within each sampling episode, across sampling strata, and among LTRMP field stations. The partitioning of effort among strata within each SRS episode (Table B-1) reflects an emphasis on off-channel areas and a recognition that these areas are probably more spatially variable than the main channel.

During 1993–96, the Onalaska Field Station participated in 14 SRS episodes. In these 14 episodes, the field team visited about 2,100 sites (Appendix B) and collected about 1,800 grab samples for chemical analyses. Most of these were analyzed for chlorophyll *a* and suspended solids, but in accord with the design for SRS, about half of the samples (1,000) were also analyzed for nitrogen and phosphorus species.

The total number of sites sampled in each episode and stratum was relatively uniform across the period of record (Table B-2). With some exceptions, 150 sites (or randomly selected alternate sites) were sampled during an episode. Exceptions were typically due to operational problems (i.e., hazardous weather and unsafe ice) that prohibited routine field operations. Inaccessible sites and the use of alternate sites were rare, and usually due to low water or a natural change in the land–water features of Pool 8 (i.e., island formation).

The SRS by the Onalaska Field Station team has conformed well to the general LTRMP design. The distribution of SRS times across the period of record (Figure D-5) showed a tendency to sample slightly later during the winter episode because of problems (e.g., equipment malfunction and samples freezing during field filtration) associated with cold mornings (temperatures below 0° C), and because there are generally more hindrances to winter sampling (e.g., unsafe ice, difficult travel, shorter duration of daylight, more equipment required, and the need to drill sampling holes in the ice). There was a minor but significant linear increase in sampling times over the years ($P < 0.05$) in backwaters and impounded areas. Although the sampling times were generally well centered on 1200 h, main channel sites tended to be sampled slightly later than other strata whereas isolated areas were sampled earlier. Although extensive steps have been taken to avoid sampling one strata later than another (e.g., grouping sites for a sampling day to cover as many strata as possible, random selection of site groups, and random selection of a starting point within a site group), the sampling protocol is being reviewed to determine whether changes can be made to improve the distribution of sampling times across the day. It is possible that logistical problems (i.e., proximity and concentration of sampling sites within a particular stratum) may prevent any further improvement without a drastic (and unrealistic) reduction in sampling efficiency.

Stratified Random Sampling Data

The SRS provides an unbiased estimate of conditions within each sampling stratum during each of four quarterly episodes per year. Seasonality, interannual variations, and long-term trends within each stratum can be assessed with summaries of these data (Appendix F), but some of the most valuable applications for these data require analyses that are beyond the scope of this report. For example, the SRS provides statistically valid estimates of the extent or frequency of limnological conditions in combination (e.g., to meet the temperature, DO, and velocity requirements of overwintering fish), and this information is being used to address changing relations among limnological variables over time, differences among the sampling strata,

and habitat availability and suitability in the Upper Mississippi River ecosystem (Fischer et al. 1997; Soballe et al. 1997).

Although the SRS data generally showed the same patterns and trends as the fixed-site data, some of the small-scale temporal variability was not as evident from the SRS data. As with the fixed-site data, the SRS results (Appendix F) indicated a general decline in total and nitrate–nitrite nitrogen concentrations in all strata except the isolated backwaters from 1993 to 1996. A slight downward trend in total phosphorus concentrations was evident at the main channel fixed sites, but a similar tendency was not detected with the SRS data. Rather, phosphorus and ammonium exhibited a more seasonally distinct pattern. Main channel water clarity also increased slightly every spring and summer during the 1993–96 period, yet a similar pattern was not evident in the backwaters.

Ammonium nitrogen peaked during the winter episodes of 1994 and 1996. Although high values of ammonium are common in winter, and the QA/QC samples and laboratory records give no reason to doubt these values, this peak occurred across all six LTRMP field stations simultaneously. Snow depths were greatest in 1994 and 1996, resulting in oxygen saturations that were much lower than in 1995. Although heavy snow and subsequently lower oxygen concentrations may have contributed to elevated ammonium, the peaks also occurred in samples from all LTRMP field stations, including those without ice and snow cover.

The strong seasonality in many monitored parameters is evident from the SRS data. Total suspended solids, volatile suspended solids, and turbidity were lowest in winter, whereas higher values were typical of other seasons. This seasonality was evident in all strata. Water clarity in Pool 8 increased considerably during the winter, and winter turbidities of less than four nephelometric turbidity units were common. Maximal winter levels were typical of both Secchi transparency and ammonium.

As with the fixed-site data, soluble reactive phosphorus tended to be lower in spring and generally higher in summer and fall. Soluble reactive phosphorus was highest in summer 1993 which corresponded to the initial receding phase of the 1993 flood. Given the high flows, it is likely that transport of soluble reactive phosphorus was great during that time. It is also likely that nitrogen transport was high, as concentrations were near or above the highest observed during the 1993–96 period. A similar peak in nitrogen occurred in spring 1995, although discharge was not as great and, therefore, transport was probably lower.

The seasonality of DO concentration as driven by solubility was evident (Figure F-2) in 1993–96, but the seasonality of chlorophyll *a* was less pronounced (Figure F-13). Although low chlorophyll *a* concentrations were common in winter, there were exceptions; substantial chlorophyll *a* concentrations were observed at times beneath the ice. For example, high concentrations were recorded when snow cover was minimal in winter 1995. Consequently, DO concentrations were also high, and supersaturated conditions prevailed for much of the winter. In winters with heavier snowfall (i.e., 1996), DO concentrations were lower and below saturation across all strata, particularly in backwaters. The lowest median summer chlorophyll *a* concentrations occurred during the 1993 flood, presumably due to the higher velocities and lower hydraulic residence times. Likewise, the lowest median DO concentration also occurred at the same time in all strata except isolated backwaters, probably due to lower phytoplankton biomass, reduced primary production, and increased oxygen demand. By contrast, chlorophyll *a* concentrations were highest in summers 1994 and 1995, when the river stage was near the seasonal norm. Slower water velocities and longer retention times may have increased phytoplankton productivity during that period.

Despite near normal water levels, summer 1996 chlorophyll *a* concentrations were lower than those in either 1994 or 1995. Several factors are probably involved, but it is possible that increased abundance of

zebra mussels (*Dreissena polymorpha*) in Pool 8 had an influence. Zebra mussel spatial coverage and abundance have not been documented in Pool 8, but anecdotal information (including personal observation) suggests that abundances have increased over the past several years. Phytoplankton removal by zebra mussels was suggested by Sullivan and Endris (1998) as a reason for increased water clarity and lower chlorophyll *a* concentrations at Lock and Dam 9 during August–September 1997. Although they did not reveal similar increases in clarity at Lock and Dam 8 during the same period, the SRS data showed a trend toward increased clarity in the main channel of Pool 8. Turbidity and suspended solids in the main channel in 1996 averaged about half the mean value seen in 1993 and were the lowest reported in the 4-year period. A similar increase in clarity was observed over the 4-year period at the main channel fixed sites. Increases in the aquatic vegetation of Pool 8 may also be contributing to greater water clarity.

For most measured parameters, the patterns and means were generally similar among strata, but variability within strata differed. Overall, variability was lower in the main channel, side channel, and impounded strata than either the backwater or isolated backwater strata because of higher velocities and more extensive mixing in the channel and impounded strata. Variability tended to be greatest in the isolated backwater stratum, followed by the contiguous backwater stratum. Influenced by wastewater treatment plants and little or no direct connection to the rest of the river, the isolated backwater stratum tended to have high ammonium and phosphorus, average total nitrogen, and low nitrate–nitrite concentrations. For many parameters, variability was lower in strata with higher water velocities. The strata could thus be ranked in order of decreasing variability as follows: (1) isolated backwaters, (2) contiguous backwaters, (3) impounded areas, (4) side channels, and (5) main channel. This ranking is not definitive; variability observed in the impounded areas overlapped that of the side channels and the variability of the side channels overlapped that observed in the main channel.

Summary and Recommendations

This report documents 4 years of LTRMP monitoring (1993–96) by the Onalaska Field Station Water Quality team and provides basic graphic and tabular summaries of the collected data. The field teams completed about 1,300 visits to fixed sampling sites and 2,100 visits to stratified random sites from 1993 through 1996. This period was marked by several important events, including the redesign of the monitoring network, the updating of field equipment in 1993, and record flooding in spring and summer 1993.

The monitoring data show that this reach of the Upper Mississippi River is moderately turbid, has near-saturated DO concentrations at most locations throughout most of the year (near midday), and has high concentrations of plant nutrients (particularly nitrogen). The hydrograph was highlighted by the late-season flood of 1993 that coincided with some of the highest nutrient and lowest DO concentrations recorded during the report period. As a result, nutrient transport was probably high during 1993. After the flood in 1993, a 4-year downward trend was observed in nitrogen, phosphorus, and suspended sediment concentrations, while water clarity steadily increased.

The tributaries to this reach are significant sources of sediment, with maximum sediment concentrations in Coon Creek, Root River, and La Crosse River (highest to lowest concentrations, respectively) and maximum nitrogen concentrations at the Root and Upper Iowa Rivers. Although the Black River had the lowest suspended sediment concentrations of all monitored tributaries, nutrient concentrations were similar to those of other tributaries.

The data indicate that long-term trends in this reach can be detected and that seasonal change (less than 1 year) can also be detected with the present design. Small-scale (e.g., diurnal) fluctuations cannot be

detected with the present design, nor does the design permit evaluation of minima or maxima (e.g., DO and temperature). To detect small-scale temporal variability and to enhance our ability to predict minima based on noon-centered measurements, differing approaches would be required. The LTRMP water quality teams are already equipped to make such measurements with continuous monitoring equipment, and some small-scale analyses and continuous monitoring have been completed (Fischer et al. 1997). The data presented demonstrate the ability of the present design to detect trends on two different temporal scales; however, the opportunity also exists to refine the scale further with minimal effort.

The water quality data from Pool 8 have proven to be valuable. They have, for example, been used for estimating the extent of suitable winter centrarchid habitat (Soballe et al. 1997), they have indicate a potential effect of zebra mussels, and will continue to provide insights. The design for SRS produces percentage estimates of “suitable” habitat based on certain species-specific criteria, but it does not describe in detail where such habitat is located within a pool. The fixed-site data provide sound information on material inputs and exports from the study reach and help gauge the impact of the surrounding basin on biota within the reach.

Questions regarding the spatial distribution of habitat or the mechanisms of habitat dynamics require information beyond that obtained from monitoring; and a combination of monitoring and focused research is required. The LTRMP water quality monitoring data will continue to provide not only a basis for the interpretation of such research results, but will also serve as a source of questions for future research.

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Appendix A. Fixed-site Sampling Sites: January 1993–December 1996

In Appendix A, we provide information on the sample collection sites used from January 1993 through December 1996. In some instances, sites not used during this period have been included for reference. The site description tables provide additional information on the locations and are keyed to the site map. The site lists are provided in three formats to allow easy cross referencing: (1) by map identifier (north–south, then east–west), (2) in alphabetical order, and (3) by habitat class. The period of record for each site is also portrayed graphically (Figure A-5) so that the duration of and interruptions in the record can be easily visualized.

Location codes (seven characters) used for routine fixed-site sampling are based on the distance upstream from the river mouth or major confluence (river miles and tenths) and on the relative left-to-right (facing upstream) location of the site between the horizontal limits of the geological–historical floodplain. Sites on the Mississippi and Illinois River main stems use a single-letter prefix (M or I, respectively), whereas tributaries and Missouri River sites use a two-letter prefix (Table A-5). The left-to-right location of a site is indicated by a suffix between A and Z. When tributary sites are sampled in midstream, they are assigned the suffix M without regard to position in the floodplain. Locations near the left or right bank (facing upstream) are indicated with an A or Z, respectively.

Habitat classes (Table A-4) are assigned to all Long Term Resource Monitoring Program sampling locations used in fixed-site monitoring. Although these classes convey significant information about the site, the fixed sites are subjectively chosen and cannot be assumed to represent the associated habitat classes (see stratified random sampling, Appendix B).

Table A-1. Long Term Resource Monitoring Program fixed-site water quality sampling locations keyed to map codes with associated period of record from 1993 through 1996, habitat class, Universal Transverse Mercator (UTM) Coordinates (zone 15, meters), and the number of sampling visits to the site.

Location code	Map identification	Period of record	Habitat class ^a	UTM		Site visits 1993–1996
				Easting	Northing	
BK14.2M	1	05/06/93–12/10/96	TRIB	633202	4868518	96
M702.7T	2	05/06/93–12/10/96	IMP	637731	4858536	94
M701.4I	3	11/13/91–07/07/93	BWC	639027	4856771	6
M701.1B	4	06/11/91–12/27/96	MC	637184	4856266	99
B001.0N	5	06/11/91–06/21/93	TRIB	640507	4855524	10
BK01.0M	6	06/28/93–12/26/96	TRIB	640611	4855524	92
M698.5B	7	05/07/93–05/07/93	BWI	636664	4853457	1
M698.3D	8	05/07/93–05/07/93	BWI	637038	4853101	1
LX00.1M	9	06/11/91–12/26/96	TRIB	640435	4853086	99
M698.1G	10	05/07/93–05/07/93	BWI	637410	4852776	1
M696.5D	11	08/17/88–12/27/96	BWC	638947	4850291	101
M694.7L	12	07/25/88–07/07/93	MC	641197	4848046	10
M694.0N	13	08/09/88–07/07/93	SC	642510	4847065	9
R000.1M	14	08/17/88–12/27/96	TRIB	640647	4846727	103
M692.5C	15	07/01/93–07/08/93	BWC	639855	4845860	2
M692.8P	16	07/21/88–07/07/93	BWC	641981	4844944	10
M692.8Q	17	07/21/88–07/07/93	BWC	642052	4844887	10
M686.4K	18	10/13/88–07/08/93	BWC	641015	4844362	10
M691.9B	19	07/01/93–07/01/93	BWC	639676	4843912	1
M691.7S	20	08/05/88–03/26/93	BWI	643127	4843457	3
M691.7T	21	08/05/88–03/26/93	BWI	643215	4843442	2
M691.3B	22	08/09/88–12/27/96	BWC	639442	4843204	104
M690.4A	23	07/01/93–07/08/93	BWC	639254	4841500	2
M689.2A	24	11/14/91–04/06/93	MC	639381	4839410	9
M687.8X	25	10/06/88–04/06/93	BWC	642793	4837376	9
M687.6G	26	05/17/89–07/02/93	BWC	639753	4836889	7
M686.1V	27	07/25/88–04/06/93	BWC	642600	4836515	9
M686.6J	28	07/22/88–03/30/93	MC	640620	4836021	7
CC04.6M	29	03/21/96–05/14/96	TRIB	647900	4834750	4
M684.8W	30	08/05/88–05/06/93	BWI	643275	4834212	4
CC00.6M	31	05/06/93–12/26/96	TRIB	643626	4834061	97
M685.0E	32	07/22/88–07/02/93	BWC	639859	4833364	11
M685.0D	33	07/22/88–04/06/93	BWC	639806	4833329	10
M681.3B	34	05/17/93–12/26/96	IMP	639935	4828911	93
M680.8U	35	07/22/88–03/11/93	IMP	642397	4828329	7
M679.5V	36	07/22/88–12/27/96	IMP	642609	4825913	100
BX00.4M	37	06/26/95–12/26/96	TRIB	644226	4820006	39
UI02.9M	38	06/26/95–12/26/96	TRIB	637926	4814694	39

^a See Table A-4 for habitat class descriptions.

Table A-2. Long Term Resource Monitoring Program fixed-site water quality sampling sites sorted by location code with associated period of record from 1993 through 1996, habitat class, Universal Transverse Mercator (UTM) Coordinates (zone 15, meters), and number of sampling visits to the site.

Location code	Map identification	Period of record	Habitat class ^a	UTM		Site visits 1993–1996
				Easting	Northing	
B001.0N	5	06/11/91–06/21/93	TRIB	640507	4855524	10
BK01.0M	6	06/28/93–12/26/96	TRIB	640611	4855524	92
BK14.2M	1	05/06/93–12/10/96	TRIB	633202	4868518	96
BX00.4M	37	06/26/95–12/26/96	TRIB	644226	4820006	39
CC00.6M	31	05/06/93–12/26/96	TRIB	643626	4834061	97
CC04.6M	29	03/21/96–05/14/96	TRIB	647900	4834750	4
LX00.1M	9	06/11/91–12/26/96	TRIB	640435	4853086	99
M679.5V	36	07/22/88–12/27/96	IMP	642609	4825913	100
M680.8U	35	07/22/88–03/11/93	IMP	642397	4828329	7
M681.3B	34	05/17/93–12/26/96	IMP	639935	4828911	93
M684.8W	30	08/05/88–05/06/93	BWI	643275	4834212	4
M685.0D	33	07/22/88–04/06/93	BWC	639806	4833329	10
M685.0E	32	07/22/88–07/02/93	BWC	639859	4833364	11
M686.1V	27	07/25/88–04/06/93	BWC	642600	4836515	9
M686.4K	18	10/13/88–07/08/93	BWC	641015	4844362	10
M686.6J	28	07/22/88–03/30/93	MC	640620	4836021	7
M687.6G	26	05/17/89–07/02/93	BWC	639753	4836889	7
M687.8X	25	10/06/88–04/06/93	BWC	642793	4837376	9
M689.2A	24	11/14/91–04/06/93	MC	639381	4839410	9
M690.4A	23	07/01/93–07/08/93	BWC	639254	4841500	2
M691.3B	22	08/09/88–12/27/96	BWC	639442	4843204	104
M691.7S	20	08/05/88–03/26/93	BWI	643127	4843457	3
M691.7T	21	08/05/88–03/26/93	BWI	643215	4843442	2
M691.9B	19	07/01/93–07/01/93	BWC	639676	4843912	1
M692.5C	15	07/01/93–07/08/93	BWC	639855	4845860	2
M692.8P	16	07/21/88–07/07/93	BWC	641981	4844944	10
M692.8Q	17	07/21/88–07/07/93	BWC	642052	4844887	10
M694.0N	13	08/09/88–07/07/93	SC	642510	4847065	9
M694.7L	12	07/25/88–07/07/93	MC	641197	4848046	10
M696.5D	11	08/17/88–12/27/96	BWC	638947	4850291	101
M698.1G	10	05/07/93–05/07/93	BWI	637410	4852776	1
M698.3D	8	05/07/93–05/07/93	BWI	637038	4853101	1
M698.5B	7	05/07/93–05/07/93	BWI	636664	4853457	1
M701.1B	4	06/11/91–12/27/96	MC	637184	4856266	99
M701.4I	3	11/13/91–07/07/93	BWC	639027	4856771	6
M702.7T	2	05/06/93–12/10/96	IMP	637731	4858536	94
R000.1M	14	08/17/88–12/27/96	TRIB	640647	4846727	103
UI02.9M	38	06/26/95–12/26/96	TRIB	637926	4814694	39

^a See Table A-4 for habitat class descriptions.

Table A-3. Long Term Resource Monitoring Program fixed-site water quality sampling locations sorted by habitat class with associated period of record from 1993 through 1996, habitat class, Universal Transverse Mercator (UTM) Coordinates (zone 15, meters), and number of sampling visits to the site.

Location code	Map identification	Period of record	Habitat class ^a	UTM		Site visits 1993–1996
				Easting	Northing	
M685.0D	33	07/22/88–04/06/93	BWC	639806	4833329	10
M685.0E	32	07/22/88–07/02/93	BWC	639859	4833364	11
M686.1V	27	07/25/88–04/06/93	BWC	642600	4836515	9
M686.4K	18	10/13/88–07/08/93	BWC	641015	4844362	10
M687.6G	26	05/17/89–07/02/93	BWC	639753	4836889	7
M687.8X	25	10/06/88–04/06/93	BWC	642793	4837376	9
M690.4A	23	07/01/93–07/08/93	BWC	639254	4841500	2
M691.3B	22	08/09/88–12/27/96	BWC	639442	4843204	104
M691.9B	19	07/01/93–07/01/93	BWC	639676	4843912	1
M692.5C	15	07/01/93–07/08/93	BWC	639855	4845860	2
M692.8P	16	07/21/88–07/07/93	BWC	641981	4844944	10
M692.8Q	17	07/21/88–07/07/93	BWC	642052	4844887	10
M696.5D	11	08/17/88–12/27/96	BWC	638947	4850291	101
M701.4I	3	11/13/91–07/07/93	BWC	639027	4856771	6
M684.8W	30	08/05/88–05/06/93	BWI	643275	4834212	4
M691.7S	20	08/05/88–03/26/93	BWI	643127	4843457	3
M691.7T	21	08/05/88–03/26/93	BWI	643215	4843442	2
M698.1G	10	05/07/93–05/07/93	BWI	637410	4852776	1
M698.3D	8	05/07/93–05/07/93	BWI	637038	4853101	1
M698.5B	7	05/07/93–05/07/93	BWI	636664	4853457	1
M679.5V	36	07/22/88–12/27/96	IMP	642609	4825913	100
M680.8U	35	07/22/88–03/11/93	IMP	642397	4828329	7
M681.3B	34	05/17/93–12/26/96	IMP	639935	4828911	93
M702.7T	2	05/06/93–12/10/96	IMP	637731	4858536	94
M686.6J	28	07/22/88–03/30/93	MC	640620	4836021	7
M689.2A	24	11/14/91–04/06/93	MC	639381	4839410	9
M694.7L	12	07/25/88–07/07/93	MC	641197	4848046	10
M701.1B	4	06/11/91–12/27/96	MC	637184	4856266	99
M694.0N	13	08/09/88–07/07/93	SC	642510	4847065	9
B001.0N	5	06/11/91–06/21/93	TRIB	640507	4855524	10
BK01.0M	6	06/28/93–12/26/96	TRIB	640611	4855524	92
BK14.2M	1	05/06/93–12/10/96	TRIB	633202	4868518	96
BX00.4M	37	06/26/95–12/26/96	TRIB	644226	4820006	39
CC00.6M	31	05/06/93–12/26/96	TRIB	643626	4834061	97
CC04.6M	29	03/21/96–05/14/96	TRIB	647900	4834750	4
LX00.1M	9	06/11/91–12/26/96	TRIB	640435	4853086	99
R000.1M	14	08/17/88–12/27/96	TRIB	640647	4846727	103
UI02.9M	38	06/26/95–12/26/96	TRIB	637926	4814694	39

^a See Table A-4 for habitat class descriptions.

Table A-4. Habitat classes used in fixed-site water quality sampling. Previous habitat classes refer to categories used from 1988 through 1993 and are now combined within each of the present habitat classes.

Present habitat class designator	Previous habitat designators included in present class	Habitat class description
BWC	BWC, BWC-O, BWC-V	Contiguous backwaters
BWI	BWI, BWI-O, BWI-V	Isolated backwaters
SC	SC, SCB, SCT, SCU	Side channels
IMP	IMP-O, IMP-V	Impounded areas
IMP-L	IMP-L	Lakes—Swan or Pepin
MC	MC, CTR, CBU, CBW, TW, TWB, TWBU, TWR-O, TWW	Main channel
TRIB	TRIB, TRM	Tributary

Table A-5. Abbreviations used to designate fixed-site sampling locations in the Long Term Resource Monitoring Program (LTRMP). Not all streams in this list have been sampled by the LTRMP. The Mackinaw, Spoon, and Sangamon Rivers are all tributaries to the Illinois River. Each site identifier includes the distance (in miles) above the tributary mouth (xx.x) and the relative location (A–Z) of the sampling site between the left and right (facing upstream) limits of the floodplain.

Site identifier	Tributary name
APxx.xM	Apple River, Missouri
ALxx.xM	Apple River, Illinois
BCxx.xM	Bob's Creek, Missouri
BFxx.xM	Buffalo River, Wisconsin
BKxx.xM	Black River, Wisconsin
BMxx.xM	Big Muddy River, Illinois
BXxx.xM	Bad Axe River, Wisconsin
CAxx.xM	Cahokia Creek, Illinois
CCxx.xM	Coon Creek, Wisconsin
CFxx.xM	Catfish Creek, Iowa
CHxx.xM	Chippewa River, Wisconsin
CNxx.xM	Cannon River, Minnesota
CRxx.xM	Cache River, Illinois
CUxx.xM	Cuivre River, Missouri
DCxx.xM	Dardenne Creek, Missouri
DMxx.xM	Des Moines River, Iowa
ERxx.xM	Elk River, Iowa
HDxx.xM	Headwaters Diversion, Missouri (formerly Little River, LRxx.xM)
Ixxx.xZ	Illinois River, Illinois
IWxx.xM	Iowa River, Iowa
LMxx.xM	LaMoines River, Illinois
LRxx.xM	Little River, Missouri (now Headwaters Diversion, HDxx.xM)

Table A-5. Continued.

Site identifier	Tributary name
LXxx.xM	La Crosse River, Wisconsin
Mxxx.xZ	Mississippi River (main stem)
MCxx.xM	Mill Creek, Iowa
MKxx.xM	Mackinaw River, Illinois
MOxx.xM	Missouri River, Missouri
MQxx.xM	Maquoketa River, Iowa
PExx.xM	Peruque Creek, Missouri
PIxx.xM	Piasa Creek, Illinois
PRxx.xM	Plum River, Illinois
QVxx.xM	Quiver Creek, Illinois
Rxxx.xM	Root River, Minnesota
RCxx.xM	Rush Creek, Illinois
Sxxx.xM	Spoon River, Illinois
SGxx.xM	Sangamon River, Illinois
SKxx.xM	Skunk River, Iowa
SXxx.xM	St. Croix River, Minnesota/Wisconsin
UIxx.xM	Upper Iowa River, Iowa
VMxx.xM	Vermillion River, Minnesota
WDxx.xM	Wood River, Illinois
WPxx.xM	Wapsipinicon River, Iowa
WSxx.xM	Wisconsin River, Wisconsin
WWxx.xM	Whitewater River, Minnesota
YLxx.xM	Yellow River, Iowa
ZMxx.xM	Zumbro River, Minnesota

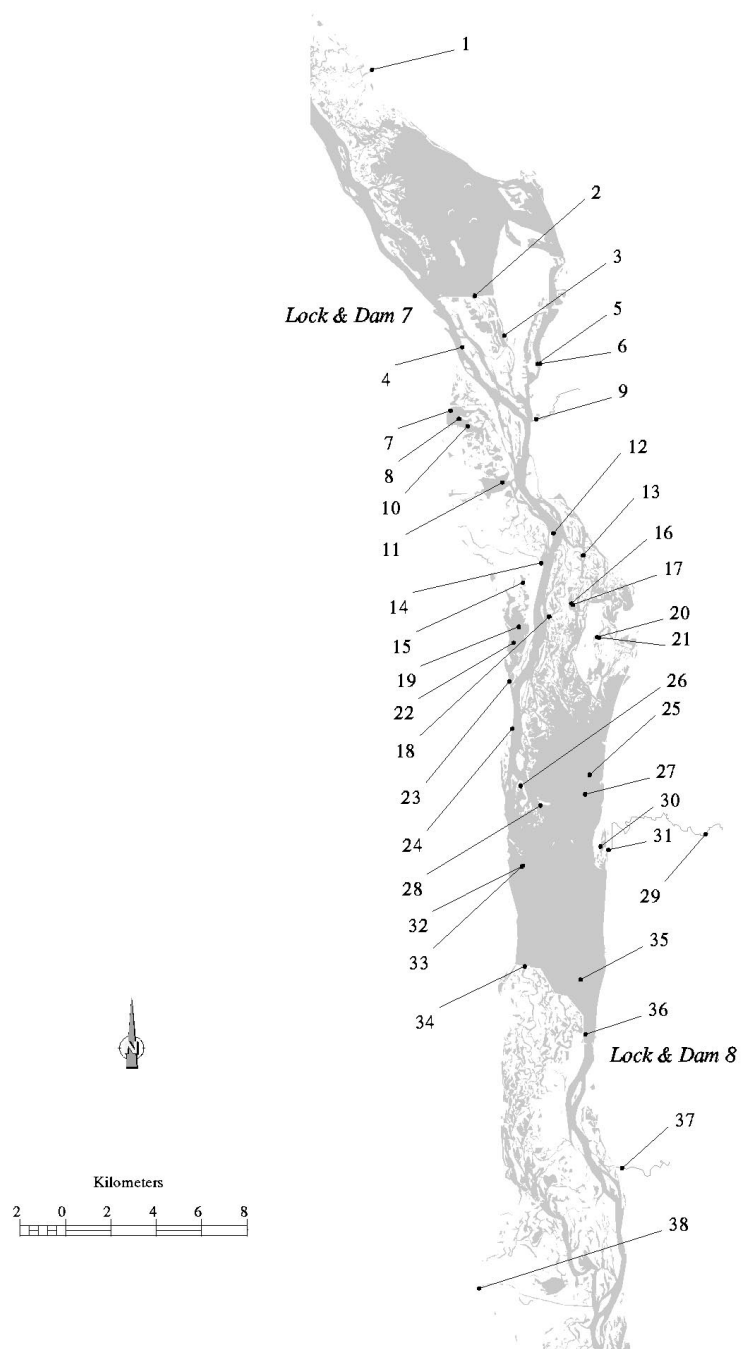
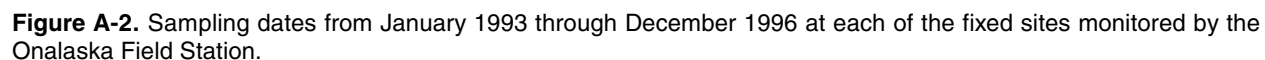


Figure A-1. Fixed-site sampling locations in the Onalaska study area.



Appendix B. Stratified Random Sampling Sites: January 1993–December 1996

Randomly selected sites are used in stratified random sampling (SRS) to provide an unbiased representation of sampling strata (and entire study areas) within each Long Term Resource Monitoring Program study reach. Individual sites are generally not resampled in subsequent SRS episodes. Information from an individual site is not intended to be interpreted in isolation, as it is only a single random measurement from all the locations within a stratum during a specific episode. When pooled together, multiple measurements (sites) from each stratum provide a statistically reliable sample of the episode and the study reach.

Unlike the fixed-site location maps (Appendix A), the maps provided for SRS do not show the individual sampling locations, but rather the sampling strata within the reach. This approach allows a legible portrayal and de-emphasizes the individual identities of SRS locations.

The tables in Appendix B show the allocation of sampling effort across the sampling strata and across the 14 SRS episodes within the 1993–96 period.

Table B-1. Sampling strata and design allocation of sampling effort for water quality stratified random sampling in the vicinity of the Onalaska Field Station. Total area of the study reach is greater than the total area included within the sampling strata due to inaccessible areas that are excluded from sampling.

Sampling stratum	Area within the stratum (ha)	Fraction of study area within the stratum (%)	Number of potential sampling sites in the stratum ^a	Number of sites assigned	Fraction of stratum sampled (%)	Fraction of total effort (%)
Main channel	1,256	14	314	25	8.0	17
Side channel	1,381	16	5,522	30	0.5	20
Backwater	1,767	20	7,067	60	0.8	40
Lake	0	0	0	0	0.0	0
Impounded	3,476	40	869	25	2.9	17
Isolated	124	1	31	10	32.3	7
Total ^b	8,727	91	13,803	150	1.1	100

^aTotal potential sites reflects a 200-m grid in most strata but a 50-m grid in side channels and backwaters.

^bTotal area refers to the entire pool or study reach and is greater than the sum of areas within the sampling strata.

Table B-2. Sampling dates and sampling activity of the Onalaska Field Station in each stratified random sampling episode from 1993 through 1996.

Sampling period			Number of samples collected/sites visited						
Episode	Start date	End date	Total	Main channel	Side channel	Contiguous backwater	Lake	Impoundment	Isolated
Summer 93	07/19/93	07/29/93	192/147	26/25	32/30	92/59	NA	29/25	13/8
Fall 93	09/20/93	09/28/93	157/148	25/25	30/30	66/60	NA	23/23	13/10
Winter 94	02/08/94	02/18/94	136/134	12/12	30/30	61/59	NA	24/24	9/9
Spring 94	05/02/94	05/10/94	173/150	25/25	30/30	76/60	NA	25/25	17/10
Summer 94	07/25/94	08/04/94	167/148	26/25	29/29	73/60	NA	25/24	14/10
Fall 94	10/10/94	10/20/94	166/149	25/24	31/31	73/59	NA	25/25	12/10
Winter 95	01/30/95	02/10/95	153/150	25/25	30/30	60/60	NA	25/25	13/10
Spring 95	05/01/95	05/12/95	157/149	25/25	31/30	59/59	NA	25/25	17/10
Summer 95	07/24/95	08/03/95	157/149	25/25	29/29	61/61	NA	25/25	17/9
Fall 95	10/09/95	10/20/95	181/150	25/25	31/30	88/60	NA	25/25	12/10
Winter 96	02/05/96	02/13/96	163/151	25/25	31/30	71/60	NA	25/25	11/11
Spring 96	04/29/96	05/06/96	177/150	25/25	30/30	77/60	NA	25/25	20/10
Summer 96	07/22/96	07/30/96	162/149	25/24	30/30	69/60	NA	25/25	13/10
Fall 96	10/07/96	10/14/96	159/150	25/25	30/30	69/60	NA	25/25	10/10

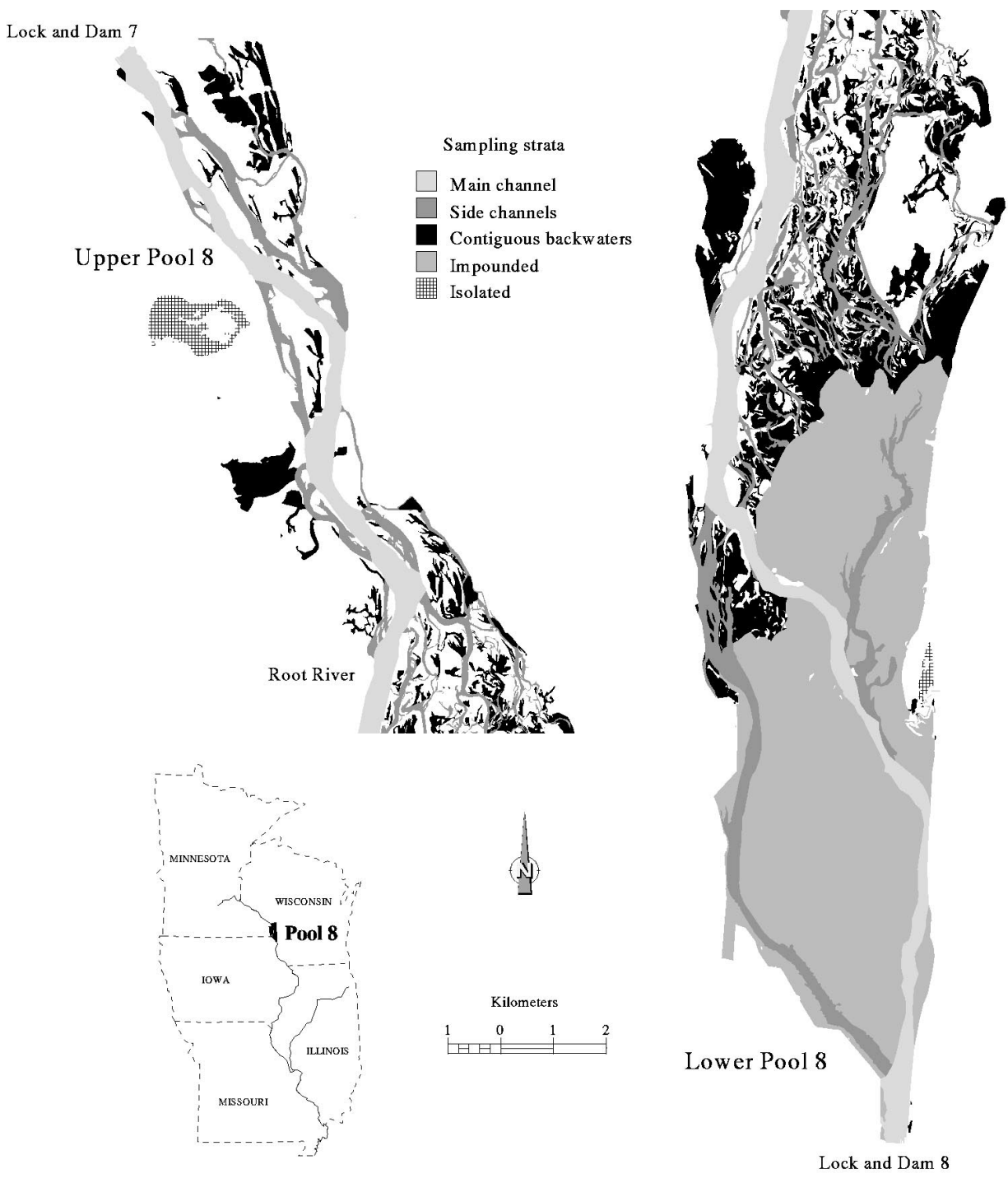


Figure B-1. Long Term Resource Monitoring Program sampling strata used in water quality stratified random sampling in the vicinity of the Onalaska Field Station.

Appendix C. Limnological Parameters Measured in the Long Term Resource Monitoring Program

Table C-1. Period of record for limnological measurements (laboratory and in situ) performed by Long Term Resource Monitoring Program field teams from 1988 through 1996.

Parameter	1988	1989	1990	1991	1992	1993– 1996
Water temperature	████	████	████	████	████	████
Dissolved oxygen	████	████	████	████	████	████
Conductivity	████	████	████	████	████	████
pH				June █	████	████
Turbidity	████	████	████	████	████	████
Secchi depth	████	████	████	████	████	████
Total suspended solids				████	████	████
Volatile suspended solids				████	████	████
Chlorophyll <i>a</i>				June █	████	████
Total phosphorus				June █	████	████
Soluble reactive phosphorus				June █	████	████
Total soluble phosphorus				June █	████	█ Apr 93
Total nitrogen				June █	████	████
Total soluble nitrogen				June █	████	█ Apr 93
NO _x (nitrate–nitrite)				June █	████	████
NH _x (ammonium)				June █	████	████
Si (silicate)				June █	████	████
Cl (chloride)				June █	████	████
Ca (calcium)				June █	████	████
Mg (magnesium)				June █	████	████
Na (sodium)				June █	████	████
K (potassium)				June █	████	████
Fe (iron)				June █	████	█ Feb 93
Mn (manganese)				June █	████	█ Feb 93
Ice and snow	████	████	████	████	████	████
Water depth	████	████	████	████	████	████
Water velocity	████	████	████	████	████	████

Table C-2. Laboratory measurements performed on limnological samples from 1988 through 1996. Each laboratory processed samples or parameters between the dates listed. The precision of result reporting is shown in parentheses. Analytical techniques are described in the procedures manuals for the Waterways Experiment Station (WES) Environmental Laboratories and by the American Public Health Association et al. (1992).

Parameter and method	Laboratory		
	WES–Vicksburg	WES–Eau Galle	UMESC ^a
Total suspended solids: Gravimetric/105° C	—	June 91–June 93 (1 µg/L)	June 93–Present (1 µg/L)
Volatile suspended solids: Gravimetric/550° C	—	June 91–June 93 (1 µg/L)	June 93–Present (1 µg/L)
Chlorophyll <i>a</i>: Fluorometric- DMSO-acetone extraction	—	—	June 93–Present (1 µg/L)
Chlorophyll <i>a</i>: Spectrophotometric 90% acetone extraction	—	June 91–June 93 (1 µg/L)	June 93–Present (1 µg/L)
Total phosphorus: Automated/ persulfate/ascorbic acid	—	June 91–Jan. 94 (1 µg/L)	Jan. 94–Present (1 µg/L)
Soluble reactive phosphorus (H): Automated/ H ₂ SO ₄ preservation, ascorbic acid	June 91–Dec. 93 (1 µg/L)	—	—
Soluble reactive phosphorus: Automated /frozen/ascorbic acid	Jan. 94–Feb. 94 (1 µg/L)	—	Feb. 94–Present (1 µg/L)
Total soluble phosphorus Automated/persulfate/ascorbic acid	—	June 91–Apr. 93 (1 µg/L)	—
Total nitrogen: Automated/Devarda's alloy	—	June 91–Jan. 94 (0.01 mg/L)	Jan. 94–Present (0.01 mg/L)
Total soluble nitrogen: Automated/Devarda's alloy	—	June 91–Apr. 93 (0.01 mg/L)	—
No_x: Automated Cd reduction, ion chromatography	June 91–Apr. 94 Automated Cd reduction (0.01 mg/L)	—	Apr.–June 94 Cd reduction June 94–Present Ion C (0.01 mg/L)
NH_x: Automated salicylate	June 91–Feb. 94 (1 µg/L)	—	Feb. 94–Present (1 µg/L)
Dissolved Si: Automated/molybdate	June 91–Feb. 94 (0.01 mg/L)	—	Mar. 94–Present (0.01 mg/L)
S0₄: Ion chromatography	—	—	Jan. 94–Present (0.1 mg/L)
Dissolved chloride: Automated ferro-cyanide, ion chromatography	June 91–June 94 Automated FeCN (0.1 mg/L)	—	June 94–Present IC (0.1 mg/L)
Dissolved calcium: Ion chromatography	—	—	Jan. 94–Present (0.1 mg/L)
Dissolved calcium: Atomic absorption	June 91–Oct. 93 (0.1 mg/L)	—	Oct. 93–Jan. 94 (0.1 mg/L)

Table C-2. Continued.

Parameter and method	Laboratory		
	WES–Vicksburg	WES–Eau Galle	UMESC ^a
Dissolved magnesium: Ion chromatography	—	—	Jan. 94–Present (0.1 mg/L)
Dissolved sodium: Ion chromatography	—	—	Jan. 94–Present (0.1 mg/L)
Dissolved potassium: Atomic absorption	June 91–Oct. 93 (0.1 mg/L)	—	Oct. 93–Present (0.1 mg/L)
Dissolved iron: Atomic absorption	June 91–Apr. 93 (0.01 mg/L)	—	—
Dissolved manganese: Atomic absorption	June 91–Apr. 93 (0.01 mg/L)	—	—

^aUMESC = Upper Midwest Environmental Sciences Center

Appendix D. Water Quality Sample Collection

Details of sample collection are important to ensure that field activities comply with the monitoring design and are producing unbiased results. The figures in Appendix D focus on site visits and sample collection times. Consistent differences in sampling times among sites, over time, or among field stations can introduce serious bias into measurements influenced by daily cycles (e.g., temperature and dissolved oxygen). Gaps in the data record can also have important ramifications for data interpretation and are therefore documented here.

Table D-1. Fixed-site sampling visit exceptions from 1993 through 1996 at the Onalaska Field Station. Table entries are keyed to numbered points on Figure D-1.

Figure code	Begin date	Site visits	Comment
1	01/04/93	17	Before sampling network redesign
2	01/25/93	21	Before sampling network redesign
3	02/01/93	17	Before sampling network redesign
4	02/15/93	4	Before sampling network redesign
5	03/01/93	17	Before sampling network redesign
6	04/12/93	4	Before sampling network redesign
7	04/27/93	0	Before sampling network redesign
8	07/05/93	19	1993 flood, old fixed sites sampled to obtain additional flood information
9	09/28/93	5	Stratified random sampling (SRS) time constraint, sampled some sites off-week when near SRS sites
10	01/24/94	5	SRS time constraint, aborted SRS because of hazardous weather and malfunctioning equipment
11	02/07/94	3	SRS time constraint, hovercraft malfunctions—some sampled off-week
12	02/14/94	2	SRS time constraint, hovercraft malfunctions—some sampled off-week
13	02/28/94	2	Hovercraft mechanical problems, sites inaccessible any other way
14	03/28/94	3	Sampled some sites during off-week, no records for explanation
15	05/09/94	3	SRS time constraint, sampled some sites off-week when near SRS sites
16	08/08/94	2	SRS time constraint, sampled some sites off-week when near SRS sites
17	12/19/95	1	Equipment problems, sampled one site during off-week
18	01/22/96	5	Sites inaccessible because of blizzard and deep snow
19	02/12/96	1	SRS, equipment problems, sampled one site during off-week
20	04/08/96	5	Staff illness and shortage, sampled boat sites during off-week

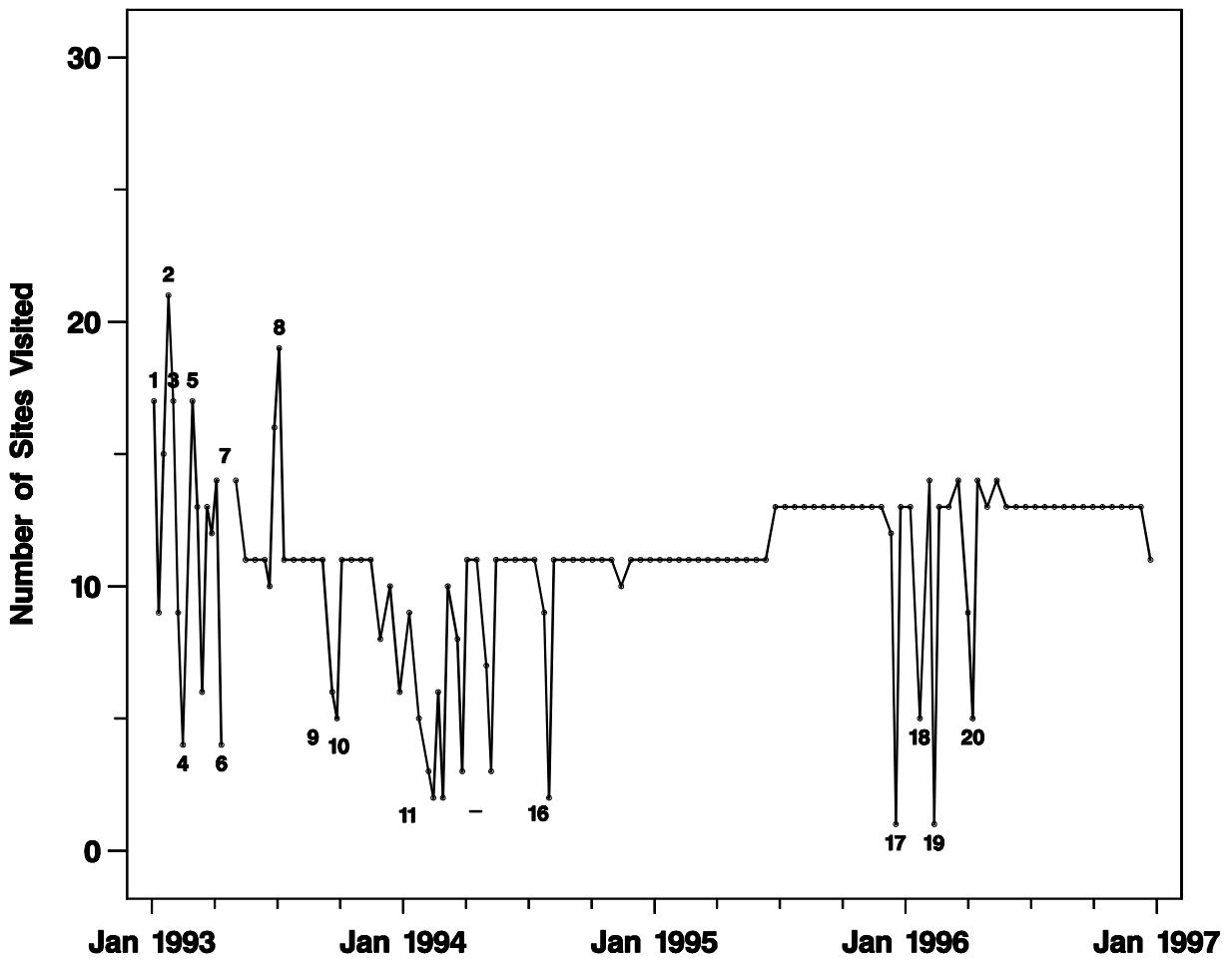


Figure D-1. Number of weekly fixed-site visits from January 1993 through December 1996 by the Onalaska Field Station. Numbered points are weeks that differ by more than one standard deviation from the mean site visits per week and are described in Table D-1.

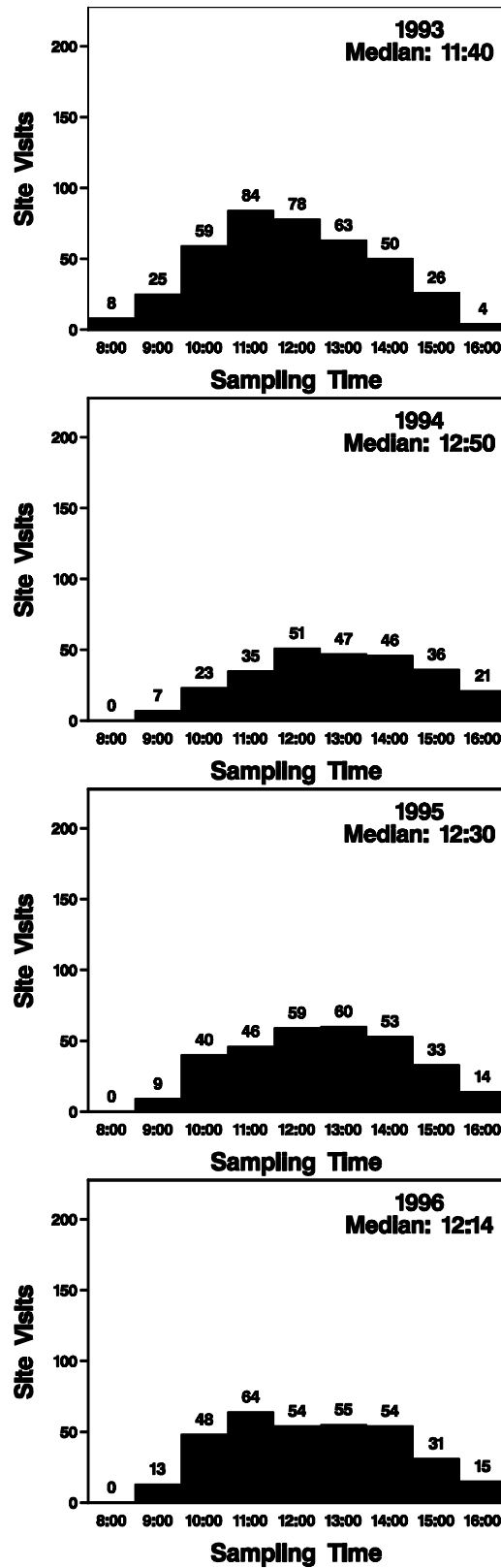


Figure D-2. Distribution of sample collection times at fixed sites from 1993 through 1996. Each bar is labeled with the number of site visits within each hourly interval.

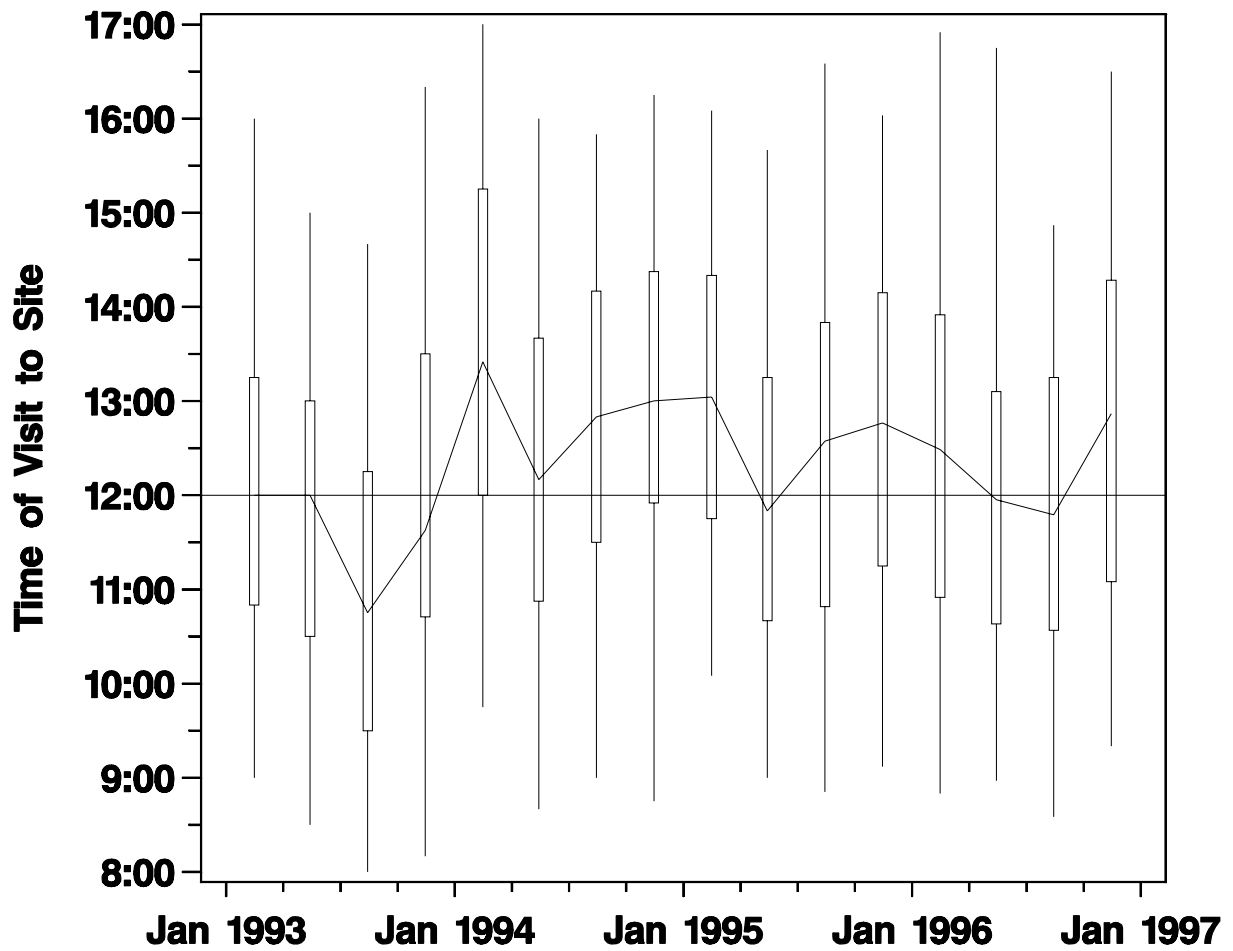


Figure D-3. Trend in fixed-site sample collection times by quarter, from 1993 through 1996. The midpoint (median) for each quarter is joined by a solid line. The box extending above and below the median denotes the 90th and 10th percentiles, respectively. The vertical line extends above and below the box to the maximum and minimum values for the quarter.

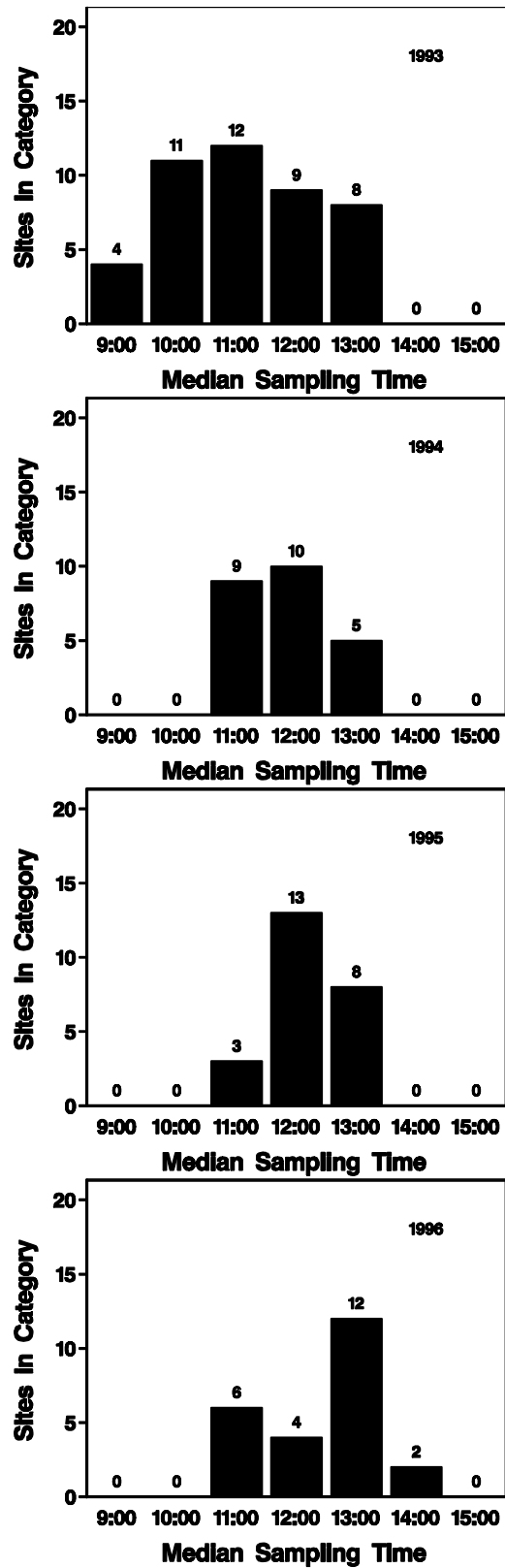


Figure D-4. Distribution of fixed sites by median sampling time at each site from 1993 through 1996.

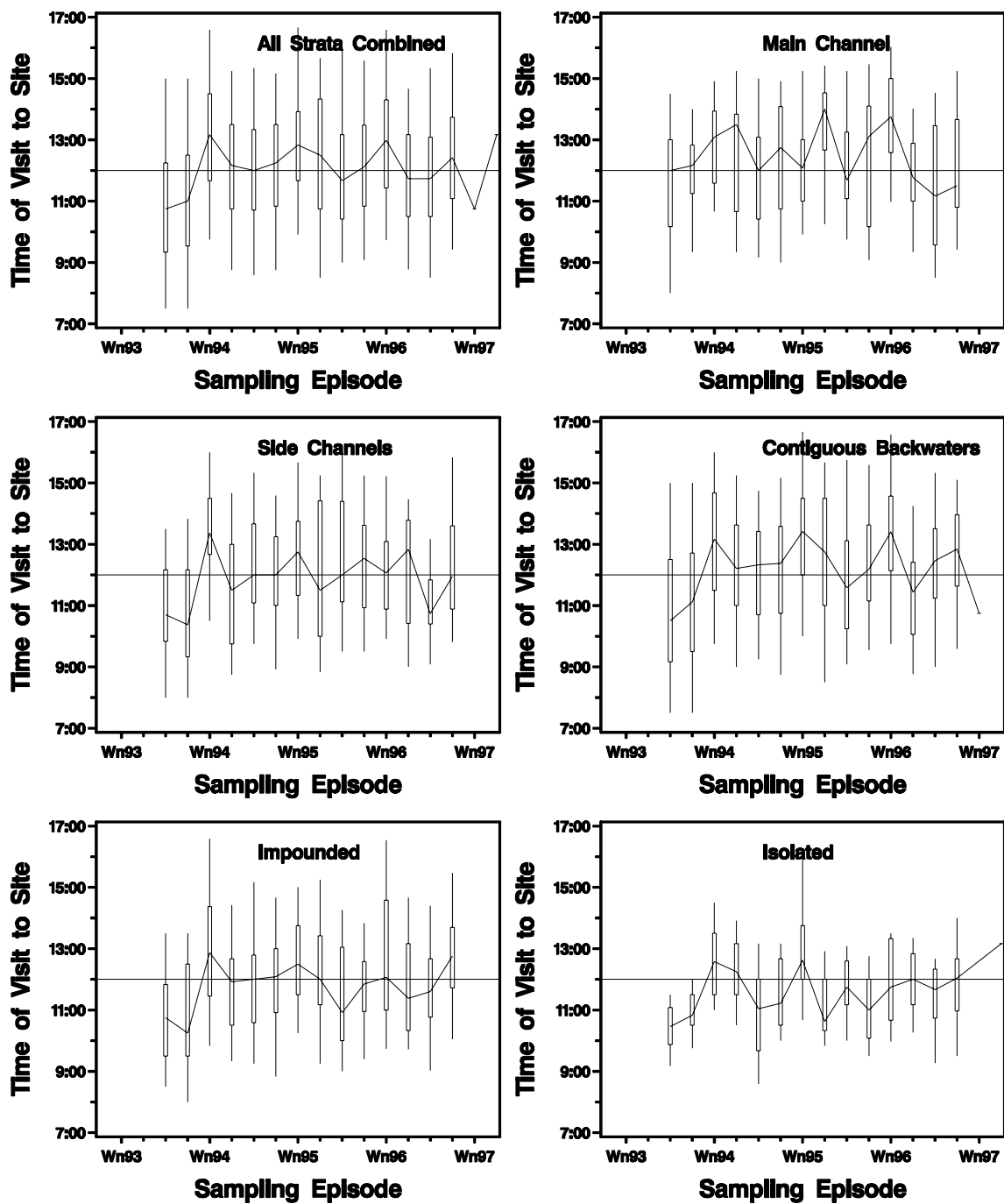


Figure D-5. Water quality sample collection times in each sampling stratum during each episode of stratified random sampling from 1993 through 1996. The midpoints (median) of the episodes are joined by a solid line. The box extending above and below the median denotes the 90th and 10th percentiles, respectively. The vertical line extends above and below each box to the maximum and minimum values for the episode.

Appendix E. Fixed-site Sampling Data: January 1993–December 1996

In Appendix E, we summarize the fixed-site monitoring data in both tabular and graphic forms. The tables contain annual statistics for each fixed site divided into two parameter groups: (1) physical and biological measurements (Table E-1), and (2) chemical data (major anions, cations, and plant nutrients; Table E-2). Within each parameter group, the data are divided by sampling depth into three groups (surface, middepth, and bottom). Chemical measurements are typically collected only at the surface and near the bottom. The majority of all measurement are in the near-surface category. Refer to Appendix A for descriptions and locations of the individual sampling sites. Sites with less than five visits during the 1993–96 period are excluded from these summaries.

The figures (E-1 and E-2) of the fixed-site data are in two formats. For sampling on the Mississippi (or Illinois) River main stems, the figures generally include separate plots of monthly means from main channel and impounded sites near the upstream and downstream ends of the reach or pool (where available). For tributary sampling, only a single plot is provided. Unlike the summary tables, these figures combine data from all sampling depths.

Data that have been flagged as questionable in the Long Term Resource Monitoring Program database are excluded from this summary. Values that are below detection are indicated by the detection limit preceded by a negative sign. Below-detection values are included in the determination of minima, maxima, and medians, but in the calculation of means and standard deviations, values below detection have been replaced by a value equal to half the detection limit. The Secchi transparency data in this report do not include observations where Secchi transparency exceeded the water column depth. High transparency conditions are thus under-represented.

Table E-1. Annual summaries (1993–1996) of physical measurements at fixed sites grouped into four categories: near-surface (less than or equal to 0.2 m below the surface), middepth, near bottom (less than or equal to 0.2 m above the substrate), and miscellaneous depths.

	Sampling location	Statistic	Sample depth	Water depth	Water velocity	Ice cover	Thickness of ice	Snow cover	Snow depth	Water temp.	Dissolved oxygen	Oxygen saturation	Specific cond.	pH	Secchi depth	Turbidity	Total suspended solids	Volatile suspended solids	Spectr. chl.	Fluor. chl.
			(m)	(m)	(m/s)	(%)	(cm)	(%)	(cm)	(°C)	(mg/L)	(%)	(µS)		(cm)	(NTU)	(mg/L)	(mg/L)	(µg/L)	(µg/L)
E2	1993 Near-surface measurements:																			
	B001.0N	Mean	0.2	2.45	0.01	100	43	50	1	10.2	11.4	100	227	7.2	112	6	5.9	3.4	—	—
		Median	0.2	2.08	0	100	43	50	1	11	11.7	94	133	7.3	111	6	4.8	2.7	—	—
		Minimum	0.2	1.78	0	100	33	0	0	0.1	8.1	85	101	5.9	80	3	3	1.8	—	—
		Maximum	0.2	3.77	0.05	100	54	100	2	23.2	14	158	490	7.8	155	12	9.8	5.6	—	—
		Std. dev.	0	0.81	0.02	0	9.18	57.7	.96	9.29	2.28	21.1	155	0.59	26.6	2.54	3.52	1.99	—	—
		N obs.	10	6	5	4	4	4	4	10	10	10	9	10	6	10	3	3	0	0
	BK01.0M	Mean	0.2	—	—	90	15	5	0	13.8	9.8	90	250	7.5	—	11	10.2	5.4	—	—
		Median	0.2	—	—	90	15	5	0	14.9	10	92	246	7.5	—	11	10.6	5.1	—	—
		Minimum	0.2	—	—	90	15	5	0	0.1	5.4	62	140	6.6	—	5	3.1	1.8	—	—
		Maximum	0.2	—	—	90	15	5	0	24.2	14.8	120	348	8.4	—	21	18.1	8.6	—	—
		Std. dev.	0	—	—	—	—	—	—	9.45	3.13	17.7	67.3	0.59	—	3.78	4.77	2.26	—	—
		N obs.	15	0	0	1	1	1	1	15	14	14	15	15	0	15	14	14	0	0
	BK14.2M	Mean	0.2	—	—	—	—	—	—	13.8	8.86	82	132	6.8	—	22	20.8	5.6	—	—
		Median	0.2	—	—	—	—	—	—	15.6	8.9	88	132	7	—	10	14.9	4.9	—	—
		Minimum	0.2	—	—	—	—	—	—	0	3.8	43	56	5.8	—	6	3.7	1.5	—	—
		Maximum	0.2	—	—	—	—	—	—	22.5	13.5	95	228	7.3	—	163	62.8	11.2	—	—
		Std. dev.	0	—	—	—	—	—	—	7.69	2.66	14.5	47.4	0.45	—	34.8	17.5	3.05	—	—
		N obs.	20	0	0	0	0	0	0	20	20	20	20	20	0	20	16	16	0	0
	CC00.6M	Mean	0.2	—	—	100	9	5	0	13.2	9.46	88	505	7.7	—	48	92.3	10.9	—	—
		Median	0.2	—	—	100	9	5	0	14.6	9.3	88	498	7.7	—	31	61.6	8.7	—	—
		Minimum	0.2	—	—	100	9	5	0	0	6.5	70	365	7.2	—	4	14.8	1.8	—	—
		Maximum	0.2	—	—	100	9	5	0	20.9	13.3	101	620	8.3	—	233	434	52.9	—	—
		Std. dev.	0	—	—	—	—	—	—	6.54	2.1	8.04	57.9	0.27	—	53.1	104	11.8	—	—
	N obs.	20	0	0	1	1	1	1	20	19	19	20	20	0	20	16	16	0	0	
LX00.1M	Mean	0.2	2.22	0.49	95	27	50	0	12.2	10.3	92	351	7.6	55.7	24	44.7	8.6	—	—	
	Median	0.2	2.28	0.54	95	27	50	0	14.3	9.9	96	340	7.7	47.5	20	31.8	7.5	—	—	
	Minimum	0.2	1.45	0.21	95	27	50	0	0	4.7	54	194	6.4	25	4	6.2	1.5	—	—	
	Maximum	0.2	3.05	0.73	95	27	50	0	24.2	14.3	124	513	8.5	135	86	123	20.3	—	—	
	Std. dev.	0	0.58	0.17	—	—	—	—	8.41	2.65	14.9	66.3	0.59	31.8	18.5	36.4	5.76	—	—	
	N obs.	24	10	8	1	1	1	1	24	23	23	24	24	10	24	16	16	0	0	
M679.5V	Mean	0.2	1.41	0.28	100	36	99	8	11.6	10.8	95	515	7.7	43.6	20	34.5	7.4	17.9	—	
	Median	0.2	1.3	0.28	100	36	100	6	12.5	10.6	93	528	7.7	37	20	34.2	8.2	13.1	—	
	Minimum	0.2	0.92	0.03	100	28	95	0	0	6.5	74	359	6.7	27	2	2.6	1.7	2.49	—	
	Maximum	0.2	3.8	0.73	100	45	100	17	24.8	16.5	138	616	8.5	140	42	65.8	11.5	82.3	—	
	Std. dev.	0	0.56	0.21	0	5.16	1.86	5.7	9.58	2.94	14.3	66.2	0.38	26.3	14.7	21	3.38	19.7	—	
	N obs.	26	26	26	7	7	7	7	26	26	26	26	26	17	26	16	16	15	0	

Table E-1. Continued.

E-3

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1993 Near-surface measurements:																			
M680.8U	Mean	0.2	2.03	0.08	100	33	99	6	0.11	13.4	92	548	7.4	170	2	—	—	—	—
	Median	0.2	2.03	0.08	100	34	100	3	0.1	13	89	565	7.5	166	2	—	—	—	—
	Minimum	0.2	1.97	0.07	100	25	95	0	0	11.3	77	454	6.4	134	2	—	—	—	—
	Maximum	0.2	2.13	0.09	100	40	100	15	0.2	16.2	111	578	7.7	208	3	—	—	—	—
	Std. dev.	0	0.06	0.01	0	4.91	1.83	6	0.09	1.65	11.2	44.4	0.45	32.3	0.53	—	—	—	—
	N obs.	7	7	7	7	7	7	7	7	7	7	7	7	6	7	0	0	0	0
M681.3B	Mean	0.2	—	—	—	—	—	—	14.4	10.9	102	514	8	37.5	23	30.9	7.7	18	—
	Median	0.2	—	—	—	—	—	—	15.8	10.5	104	528	8	38.5	25	35.1	8.5	18	—
	Minimum	0.2	—	—	—	—	—	—	0.2	6.2	73	422	7.3	27	4	2.9	1.9	18	—
	Maximum	0.2	—	—	—	—	—	—	25.1	17.8	136	614	8.6	46	52	70.3	13.1	18	—
	Std. dev.	0	—	—	—	—	—	—	8.89	3.38	17.1	46.7	0.37	9.47	14	22	3.41	—	—
	N obs.	17	0	0	0	0	0	0	17	17	17	17	17	4	16	14	14	1	0
M685.0D	Mean	0.2	1.55	0.11	100	33	94	6	0.83	13.9	97	528	7.5	84.4	21	—	—	—	—
	Median	0.2	1.49	0.07	100	33	100	3	0.1	13.4	92	563	7.5	113	3	—	—	—	—
	Minimum	0.2	1.41	0.04	100	26	50	0	0	11.9	88	327	7.1	9	3	—	—	—	—
	Maximum	0.2	2.15	0.34	100	38	100	15	5.7	17.9	123	611	7.7	148	153	—	—	—	—
	Std. dev.	0	0.22	0.1	0	4.02	17.6	5.6	1.82	1.77	10.8	91.3	0.22	60.7	47.2	—	—	—	—
	N obs.	10	10	10	8	8	8	8	10	10	10	10	10	5	10	0	0	0	0
M685.0E	Mean	0.2	1.15	0.09	100	37	100	7	2.68	13.4	96	511	7.5	27.3	22	30.5	8	4.37	—
	Median	0.2	0.95	0.02	100	38	100	4	0.1	13.3	92	507	7.4	31	3	30.5	8	4.37	—
	Minimum	0.2	0.87	0.01	100	28	98	0	0	6.2	70	330	7.1	8	2	30.5	8	4.37	—
	Maximum	0.2	2.8	0.38	100	44	100	18	21.2	18.6	128	622	7.9	43	153	30.5	8	4.37	—
	Std. dev.	0	0.57	0.13	0	5.94	0.76	6.9	6.38	3.15	15.4	92	0.29	17.8	45	—	—	—	—
	N obs.	11	11	11	7	7	7	7	11	11	11	11	11	3	11	1	1	1	0
M686.1V	Mean	0.2	1.24	0.08	100	33	100	5	1.14	13.3	94	463	7.3	51	6	—	—	—	—
	Median	0.2	1.16	0.06	100	33	100	3	0.2	13.1	91	497	7.3	51	3	—	—	—	—
	Minimum	0.2	1.12	0.05	100	23	99	0	0	12.1	83	294	6.7	48	2	—	—	—	—
	Maximum	0.2	1.7	0.23	100	39	100	15	6.3	16.3	112	545	7.8	54	17	—	—	—	—
	Std. dev.	0	0.2	0.06	0	5.13	0.38	5.3	2.17	1.26	9.5	98	0.42	4.24	5.59	—	—	—	—
	N obs.	9	9	9	7	7	7	7	9	9	9	9	8	2	9	0	0	0	0
M686.4K	Mean	0.2	1.13	0.18	100	38	100	7	4.89	12.9	96	502	7.5	44.7	12	34.7	5.9	6.24	—
	Median	0.2	0.83	0.09	100	38	100	4	0.1	13.5	96	526	7.5	42	3	34.7	5.9	6.24	—
	Minimum	0.2	0.76	0.06	100	26	99	0	0	6.5	75	388	7	40	2	25.1	3.7	5.61	—
	Maximum	0.2	2.5	0.48	100	57	100	16	22	17.4	119	601	8	52	38	44.3	8	6.86	—
	Std. dev.	0	0.6	0.16	0	9.85	0.38	6	8.63	3.44	12.7	79.7	0.35	6.43	13.7	13.6	3.09	0.88	—
	N obs.	11	11	11	7	7	7	7	11	11	11	11	10	3	11	2	2	2	0

Table E-1. Continued.

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1993 Near-surface measurements:																			
M686.6J	Mean	0.2	1.68	0.14	100	38	100	7	0.61	13.4	94	515	7.5	132	4	—	—	—	—
	Median	0.2	1.62	0.13	100	39	100	5	0	13.5	92	548	7.7	148	3	—	—	—	—
	Minimum	0.2	1.52	0.11	100	32	98	0	0	12.6	86	413	6.6	77	2	—	—	—	—
	Maximum	0.2	2.01	0.27	100	43	100	15	4	14.6	111	574	8.2	157	10	—	—	—	—
	Std. dev.	0	0.17	0.06	0	3.66	0.82	5.4	1.49	0.63	8.23	63.5	0.58	32.9	2.79	—	—	—	—
	N obs.	7	7	7	6	6	6	6	7	7	7	7	6	5	7	0	0	0	0
M687.6G	Mean	0.2	0.64	0	100	33	100	5	4.12	9.72	75	775	7.6	38	8	13.7	5.2	4.99	—
	Median	0.2	0.44	0	100	32	100	2	0.55	7.3	84	863	7.5	38	6	13.7	5.2	4.99	—
	Minimum	0.2	0.4	0	100	28	99	0	0.2	1.8	12	390	7	38	3	13.7	5.2	4.99	—
	Maximum	0.2	1.7	0	100	38	100	14	22	21	149	905	8.5	38	19	13.7	5.2	4.99	—
	Std. dev.	0	0.52	0	0	4.36	0.45	5.9	8.77	7.83	54.9	218	0.55	—	6.3	—	—	—	—
	N obs.	7	6	6	5	5	5	5	6	5	5	5	5	1	5	1	1	1	0
M687.8X	Mean	0.2	2.45	0.16	100	34	100	7	1.12	13.5	95	463	7.4	129	6	2.3	1.3	2.67	—
	Median	0.2	2.43	0.1	100	35	100	3	0.2	13	96	495	7.4	152	3	2.3	1.3	2.67	—
	Minimum	0.2	2.2	0.07	100	27	100	1	0	12	82	291	6.8	43	2	2.3	1.3	2.67	—
	Maximum	0.2	2.99	0.47	100	41	100	15	6	16.1	110	555	8.1	198	19	2.3	1.3	2.67	—
	Std. dev.	0	0.23	0.14	0	4.76	0	6.4	2.06	1.58	11.1	102	0.39	51.9	6.05	—	—	—	—
	N obs.	9	9	9	7	7	7	7	9	9	9	9	8	9	9	1	1	1	0
M689.2A	Mean	0.2	2.26	0.28	100	22	92	6	1.21	13.1	93	535	7.4	124	13	—	—	—	—
	Median	0.2	2.15	0.23	100	21	100	6	0.1	13.1	92	560	7.3	143	3	—	—	—	—
	Minimum	0.2	1.81	0.18	100	16	50	0	0	11.7	87	443	6.8	28	3	—	—	—	—
	Maximum	0.2	2.81	0.61	100	27	100	13	5.5	14.3	103	601	8.1	201	53	—	—	—	—
	Std. dev.	0	0.35	0.14	0	3.45	18.7	4.8	2.29	0.77	5.36	61.4	0.48	60.5	18.7	—	—	—	—
	N obs.	9	8	9	7	7	7	7	9	8	8	9	8	9	9	0	0	0	0
M691.3B	Mean	0.2	1.26	0.04	99.9	31	75	5	11.9	11.4	104	480	7.7	52	15	17.8	8.3	31.1	—
	Median	0.2	1	0	100	35	100	5	13.2	11.8	103	473	7.8	50	10	15.6	7.7	29.5	—
	Minimum	0.2	0.8	0	99	8	0	0	0.2	5.6	61	221	6.2	19	2	0.9	0.7	1.25	—
	Maximum	0.2	2.6	0.34	100	39	100	12	27	17.8	191	686	8.6	100	63	35.6	18.3	66.6	—
	Std. dev.	0	0.55	0.08	0.32	8.98	42.5	4.6	9.5	3.13	31.8	124	0.6	19.8	14.9	11	4.86	21.7	—
	N obs.	27	27	27	10	10	10	10	27	27	27	26	26	21	27	15	15	14	0
M692.8P	Mean	0.2	0.87	0.27	99.7	16	93	7	3.11	13.1	95	464	7.5	49.3	8	21.6	6.7	4.28	—
	Median	0.2	0.71	0.25	100	15	100	4	0.1	14.4	100	501	7.6	54	4	21.6	6.7	4.28	—
	Minimum	0.2	0.47	0.13	99	9	60	0	0	6	69	311	6.9	30	3	21.6	6.7	4.28	—
	Maximum	0.2	1.9	0.52	100	25	100	18	22.2	15.5	106	562	8.1	64	19	21.6	6.7	4.28	—
	Std. dev.	0	0.45	0.13	0.52	5.79	16	7.7	6.91	2.78	11.6	86.7	0.4	17.5	7.13	—	—	—	—
	N obs.	10	10	10	6	6	6	6	10	10	10	10	10	3	10	1	1	1	0

Table E-1. Continued.

	Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
			1993 Near-surface measurements:																	
E-5	M692.8Q	Mean	0.2	0.97	0.3	100	22	93	7	3.12	12.9	93	457	7.6	52.3	8	23.8	5.5	5.35	—
		Median	0.2	0.91	0.22	100	23	100	4	0.1	13.8	96	492	7.5	52	3	23.8	5.5	5.35	—
		Minimum	0.2	0.84	0.15	100	8	60	0	0	5.8	67	304	7.2	45	3	23.8	5.5	5.35	—
		Maximum	0.2	1.3	0.6	100	30	100	20	22.2	15.2	106	544	8.1	60	21	23.8	5.5	5.35	—
		Std. dev.	0	0.15	0.16	0	7.79	16	8	6.89	2.76	12	86.5	0.35	7.51	7.77	—	—	—	—
		N obs.	10	10	10	6	6	6	6	10	10	10	10	10	10	3	10	1	1	1
	M694.0N	Mean	0.2	1.72	0.2	100	18	71	4	3.39	12.4	90	450	7.4	99.7	8	27.2	7.1	4.37	—
		Median	0.2	1.6	0.11	100	19	99	2	0.1	12.7	90	468	7.4	103	4	27.2	7.1	4.37	—
		Minimum	0.2	0.8	0.07	100	7	5	0	0	5.9	68	308	6.9	41	3	27.2	7.1	4.37	—
		Maximum	0.2	4	0.51	100	26	100	9	22	15.3	105	534	7.9	153	22	27.2	7.1	4.37	—
		Std. dev.	0	0.92	0.16	0	7.26	42.6	4.4	7.15	2.71	11.5	87.4	0.3	51.3	7.24	—	—	—	—
		N obs.	9	9	9	5	5	5	5	9	9	9	9	9	9	6	9	1	1	1
	M694.7L	Mean	0.2	1.53	0.48	91.7	13	71	2	3.06	12.9	94	500	7.4	82.5	9	41.1	7.6	4.81	—
		Median	0.2	0.91	0.32	100	11	88	1	0.15	13.4	93	504	7.4	63.5	3	41.1	7.6	4.81	—
		Minimum	0.2	0.73	0.13	50	3	0	0	0	6.3	72	372	6.7	32	2	41.1	7.6	4.81	—
		Maximum	0.2	3.6	1.1	100	35	100	4	22	15.4	108	587	8.1	171	34	41.1	7.6	4.81	—
		Std. dev.	0	1.05	0.34	20.4	11.3	40.1	1.8	6.85	2.57	10.6	76.7	0.4	61.4	10.8	—	—	—	—
		N obs.	10	10	10	6	6	6	6	10	10	10	10	10	10	4	10	1	1	1
	M696.5D	Mean	0.2	1.57	0.02	97.5	37	74	5	11.9	10.1	91	504	7.6	56.3	12	13.7	6.1	18.6	—
		Median	0.2	1.3	0.01	100	43	100	4	13.2	10.3	91	520	7.7	55.5	11	12.9	6.1	16.1	—
		Minimum	0.2	0.5	0	90	9	0	0	0	5.2	51	371	6.5	30	4	3.9	3.3	7.48	—
		Maximum	0.2	3.3	0.1	100	54	100	16	25.3	15.4	160	651	8.6	77	25	24.9	8.4	33.7	—
		Std. dev.	0	0.84	0.03	4.63	18.1	45.7	6.1	9.48	3.05	22.8	71.2	0.59	13.9	5.31	5.24	1.62	9.3	—
		N obs.	26	26	26	8	8	8	8	26	26	26	26	26	26	22	26	15	15	14
M701.1B	Mean	0.2	2.31	0.41	100	26	100	5	12.9	10.1	91	447	7.6	67.2	15	17.8	5.5	15	—	
	Median	0.2	2.24	0.45	100	26	100	5	15.3	10.2	90	484	7.7	55	13	15.5	5.7	11.9	—	
	Minimum	0.2	1	0.09	100	23	100	2	0	6.2	68	201	6.3	28	3	2.3	1.7	1.5	—	
	Maximum	0.2	3.5	0.74	100	28	100	7	24	14.9	121	563	8.5	175	35	43	10.1	71.1	—	
	Std. dev.	0	0.7	0.24	0	3.54	0	3.5	8.91	3.15	13	93.7	0.52	39.1	8.71	11	2.19	15.9	—	
	N obs.	23	22	23	2	2	2	2	23	23	23	23	22	22	23	16	16	16	0	
M701.4I	Mean	0.2	1.7	0.1	100	37	75	5	5.33	9.9	76	381	7	59.5	7	15.7	4.3	4.81	—	
	Median	0.2	0.98	0	100	38	100	6	1.1	11.2	84	430	7	59.5	5	15.7	4.3	4.81	—	
	Minimum	0.2	0.71	0	100	28	0	0	0.2	3.4	24	120	6.4	50	3	15.7	4.3	4.81	—	
	Maximum	0.2	4.2	0.46	100	44	100	8	22.2	14.5	102	526	7.6	69	15	15.7	4.3	4.81	—	
	Std. dev.	0	1.42	0.19	0	6.9	49.8	3.6	8.63	4.33	27.5	161	0.46	13.4	4.68	—	—	—	—	
	N obs.	6	6	6	4	4	4	4	6	6	6	5	6	2	6	1	1	1	0	

Table E-1. Continued.

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1993 Near-surface measurements:																			
M702.7T	Mean	0.2	—	—	93.3	6	25	1	14.5	9.65	90	333	7.5	—	14	15.4	5.7	5.99	—
	Median	0.2	—	—	90	5	5	1	16.7	9.4	94	367	7.5	—	12	11.4	5.2	5.99	—
	Minimum	0.2	—	—	90	2	0	0	0.3	5.6	61	42	5.9	—	4	3.1	2.2	5.99	—
	Maximum	0.2	—	—	100	10	70	1	24.1	16.3	112	577	8.3	—	38	52	13.5	5.99	—
	Std. dev.	0	—	—	5.77	4.04	39.1	.71	8.31	3.14	13.6	155	0.62	—	8.75	13.5	3.19	—	—
	N obs.	20	0	0	3	3	3	2	20	19	19	20	20	0	20	16	16	1	0
R000.1M	Mean	0.2	1.56	0.7	87.6	30	95	2	10.1	10.5	89	550	7.8	47.2	38	62.1	8.5	2.87	—
	Median	0.2	1.4	0.72	95	31	99	0	10.9	10.6	93	580	7.8	40	20	37.8	6.7	2.87	—
	Minimum	0.2	0.7	0.26	50	16	80	0	0	5.2	59	255	6.7	8	5	13.9	2.3	2.62	—
	Maximum	0.2	3.3	1.1	99	46	100	10	21.9	13.8	107	648	8.7	111	175	229	34.3	3.12	—
	Std. dev.	0	0.66	0.18	21.1	12.6	8.38	4.4	7.93	2.61	11.6	87.9	0.5	27.6	42.6	58.9	7.82	0.35	—
	N obs.	28	28	24	5	5	5	5	28	28	28	28	28	21	28	17	17	2	0
1993 Near-bottom measurements:																			
M691.3B	Mean	0.98	1.18	—	—	—	—	—	15.6	10.8	106	421	8.2	—	16	—	—	—	—
	Median	1	1.2	—	—	—	—	—	14.4	10.5	116	421	8.2	—	16	—	—	—	—
	Minimum	0.6	0.8	—	—	—	—	—	3	3.5	42	421	8.2	—	16	—	—	—	—
	Maximum	1.3	1.5	—	—	—	—	—	24.8	17	171	421	8.2	—	16	—	—	—	—
	Std. dev.	0.24	0.25	—	—	—	—	—	8.21	4	38.8	—	—	—	—	—	—	—	—
	N obs.	9	9	0	—	—	—	—	9	9	9	1	1	—	1	0	0	0	0
M696.5D	Mean	1.37	1.56	0.01	—	—	—	—	16.2	8.05	78	472	7.7	—	9	—	—	—	—
	Median	1.3	1.48	0.01	—	—	—	—	16.2	6.2	74	472	7.7	—	9	—	—	—	—
	Minimum	1	1.2	0	—	—	—	—	3.5	4.4	43	454	7.1	—	9	—	—	—	—
	Maximum	1.8	2.02	0.02	—	—	—	—	24.3	14.3	108	490	8.4	—	9	—	—	—	—
	Std. dev.	0.37	0.37	0.01	—	—	—	—	7.86	3.89	25.9	25.5	0.93	—	—	—	—	—	—
	N obs.	6	6	2	—	—	—	—	6	6	6	2	2	—	1	0	0	0	0
1994 Near-surface measurements:																			
BK01.0M	Mean	0.2	—	—	93.8	18	74	5	12.2	10.7	100	287	7.8	108	8	9.1	5	—	—
	Median	0.2	—	—	97.5	22	98	5	11.8	10.8	94	281	7.9	108	6	7.9	4.7	—	—
	Minimum	0.2	—	—	80	4	0	0	0	7	63	117	6.1	96	4	1.1	0.5	—	—
	Maximum	0.2	—	—	100	26	100	10	25.2	14.7	164	482	9	120	22	20.9	14.6	—	—
	Std. dev.	0	—	—	9.46	9.81	49.2	4.2	9.55	2.07	23.3	90	0.75	17	4.9	5.89	3.44	—	—
	N obs.	26	0	0	4	4	4	4	26	25	25	26	26	2	25	25	25	0	0

Table E-1. Continued.

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1994 Near-surface measurements:																			
BK14.2M	Mean	0.2	—	—	99	4	99	5	11.3	10.4	97	158	7.4	—	16	18.4	5.3	—	—
	Median	0.2	—	—	99	4	99	5	12.3	10.4	93	159	7.5	—	13	14.9	4.9	—	—
	Minimum	0.2	—	—	99	1	99	5	0	5.8	67	71	6.1	—	5	3.4	0.1	—	—
	Maximum	0.2	—	—	99	7	99	5	25.1	13.4	139	263	8.9	—	58	75.6	16.2	—	—
	Std. dev.	0	—	—	0	4.24	0	—	9.16	1.91	15.7	38.8	0.67	—	11.8	16	3.8	—	—
	N obs.	26	0	0	2	2	2	1	26	23	23	26	26	0	26	25	25	0	0
CC00.6M	Mean	0.2	1.63	—	98.3	30	97	9	10.4	10.4	92	513	7.9	47	26	66.8	7.7	—	—
	Median	0.2	1.6	—	100	33	100	8	12.2	9.8	92	512	8	50	24	63	6.7	—	—
	Minimum	0.2	1.5	—	95	10	90	1	-0.2	8	80	469	6.4	40	8	11.1	1.4	—	—
	Maximum	0.2	1.8	—	100	47	100	18	22.1	15.2	104	627	8.3	51	70	207	21	—	—
	Std. dev.	0	0.13	—	2.89	18.7	5.77	8.5	7.26	1.85	5.13	36.8	0.41	6.08	16	48	5.31	—	—
	N obs.	26	4	0	3	3	3	3	26	25	25	25	26	3	26	25	25	0	0
LX00.1M	Mean	0.2	1.6	0.55	100	28	100	2	12.1	10.8	101	342	7.9	89.5	26	52.7	9.5	—	—
	Median	0.2	1.6	0.55	100	28	100	2	12.7	11	94	339	8	89.5	25	59.9	9.8	—	—
	Minimum	0.2	1.4	0.55	100	28	100	2	0	7.5	72	280	6.4	49	5	6.5	1.3	—	—
	Maximum	0.2	1.8	0.55	100	28	100	2	25.9	13.5	141	423	8.7	130	58	132	22.4	—	—
	Std. dev.	0	0.28	—	—	—	—	—	8.53	1.68	18.7	32	0.59	57.3	13.9	32.6	5.95	—	—
	N obs.	24	2	1	1	1	1	1	24	23	23	24	24	2	23	23	23	0	0
M679.5V	Mean	0.2	1.45	0.18	98.3	19	65	7	14.2	11.2	108	444	8.2	50	21	29.8	8.2	40.9	—
	Median	0.2	1.34	0.19	100	15	95	6	14.9	10.8	108	440	8.3	48.5	20	31.3	9.2	34.5	—
	Minimum	0.2	0.68	0.03	95	11	0	0	-0.1	4.6	33	388	7.3	29	2	1	0.9	1.34	—
	Maximum	0.2	2.53	0.39	100	32	100	16	25.7	16.4	153	527	9	85	43	67.8	17.9	133	—
	Std. dev.	0	0.51	0.1	2.89	11.2	56.3	8.1	9.09	2.79	25.3	37.2	0.41	15.3	11	19.4	4.51	31.5	—
	N obs.	22	22	22	3	3	3	3	22	22	22	21	22	20	21	21	21	22	0
M681.3B	Mean	0.2	0.85	—	100	5	100	3	12.4	11.3	105	450	8.1	—	23	30.8	7.9	—	14.5
	Median	0.2	0.85	—	100	5	100	3	14.2	10.9	100	446	8.2	—	21	25	7.5	—	14.5
	Minimum	0.2	0.7	—	100	5	100	3	0	6.3	69	295	6.8	—	2	1.4	0.9	—	14.5
	Maximum	0.2	1	—	100	5	100	3	25.7	16	156	623	8.9	—	83	93	17.8	—	14.5
	Std. dev.	0	0.21	—	—	—	—	—	9.61	2.4	21.8	60.9	0.53	—	18.8	24.2	5.13	—	—
	N obs.	25	2	0	1	1	1	1	25	24	24	23	25	0	25	24	24	0	1
M691.3B	Mean	0.2	0.88	0.01	100	23	48	1	14.2	11.8	115	395	8.2	53.4	14	17.7	8.7	33.3	—
	Median	0.2	0.79	0	100	19	50	1	14.9	10.7	108	373	8.4	50.5	12	15.7	9.3	40.4	—
	Minimum	0.2	0.55	0	100	4	0	0	0.1	1.1	8	268	6.6	35	2	1.4	0.6	3.37	—
	Maximum	0.2	1.56	0.04	100	41	100	5	26.5	21.2	198	771	9.4	98	35	43.9	20	62.1	—
	Std. dev.	0	0.25	0.01	0	15.6	47.6	2.1	9.38	4.59	42.5	103	0.68	15.7	7.91	11.8	5.23	18.9	—
	N obs.	23	22	22	5	5	5	5	23	23	23	23	23	16	23	22	22	23	0

Table E-1. Continued.

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1994 Near-surface measurements:																			
M696.5D	Mean	0.2	1.03	0.01	97.5	28	42	4	13.3	10.9	103	462	8	51.7	19	22.5	8.1	31	50.7
	Median	0.2	1	0	100	26	25	0	14.5	10.8	94	459	7.9	51	17	18.3	7.5	28.1	50.7
	Minimum	0.2	0.32	0	85	3	0	0	0	5.8	49	363	6.9	26	3	2.4	1.3	1.34	50.7
	Maximum	0.2	1.5	0.04	100	53	100	12	26	20	172	573	9	100	61	77.3	17.3	107	50.7
	Std. dev.	0	0.31	0.01	6.12	18.2	46.7	5.5	9.84	3.2	31.2	49.4	0.5	20.2	13	17.5	4.96	29.5	—
	N obs.	23	23	23	6	6	6	6	23	23	23	23	23	20	22	22	22	23	1
M701.1B	Mean	0.2	2.03	0.27	97.5	18	98	7	12.6	10.7	98	413	8	64.9	15	18.2	6.5	27.7	—
	Median	0.2	1.87	0.25	97.5	18	98	7	13.1	10.6	93	409	8.1	61	13	15.5	6.4	19.1	—
	Minimum	0.2	0.9	0.12	95	13	95	2	0	6.5	71	311	6.9	25	3	1.4	1.3	1.73	—
	Maximum	0.2	3.4	0.53	100	22	100	11	24.7	16.3	133	583	8.7	165	37	45.9	14.7	99.5	—
	Std. dev.	0	0.62	0.11	3.54	6.36	3.54	6.4	9.25	2.75	16.9	64.5	0.49	32	8.15	12.4	3.65	23.8	—
	N obs.	24	24	23	2	2	2	2	24	24	24	24	24	24	24	23	23	24	0
M702.7T	Mean	0.2	0.97	0.04	98	28	44	5	12.5	10.8	100	311	7.8	85.7	10	20.6	5.4	—	—
	Median	0.2	1	0.04	100	34	20	2	13.8	10.2	93	303	7.9	66	9	10.6	4.8	—	—
	Minimum	0.2	0.7	0.04	90	3	0	0	0	5.9	70	136	6.3	61	2	0.7	0.8	—	—
	Maximum	0.2	1.2	0.04	100	44	100	12	24.1	17.8	212	565	9	130	28	237	14.7	—	—
	Std. dev.	0	0.25	—	4.47	15.6	51.8	5.8	9.48	2.95	30.2	118	0.67	38.5	6.08	47.6	3.42	—	—
	N obs.	24	3	1	5	5	5	5	24	23	23	23	24	3	24	23	23	0	0
R000.1M	Mean	0.2	1.32	0.68	95	58	95	8	12.5	10.5	97	537	7.9	54.6	25	60.7	7.7	—	—
	Median	0.2	1.21	0.68	95	58	95	8	13.4	9.9	95	539	8.1	52.5	20	43.1	6.4	—	—
	Minimum	0.2	0.72	0.54	95	58	95	8	-0.1	8.9	85	406	6.8	16	6	2.4	1.1	—	—
	Maximum	0.2	2	0.81	95	58	95	8	25.8	13.7	115	644	8.4	101	120	335	30.4	—	—
	Std. dev.	0	0.37	0.19	—	—	—	—	7.98	1.48	7.42	45.8	0.4	22.6	24.2	69.1	6.36	—	—
	N obs.	23	14	2	1	1	1	1	23	23	23	23	23	12	23	22	22	0	0
1994 Near-bottom measurements:																			
M691.3B	Mean	0.78	0.98	—	—	—	—	—	18.2	8.33	90	348	8.7	—	—	—	—	—	—
	Median	0.75	0.96	—	—	—	—	—	20.6	8.55	93	348	8.7	—	—	—	—	—	—
	Minimum	0.6	0.78	—	—	—	—	—	2.1	5.5	55	348	8.7	—	—	—	—	—	—
	Maximum	1.1	1.3	—	—	—	—	—	24.1	10	119	348	8.7	—	—	—	—	—	—
	Std. dev.	0.19	0.2	—	—	—	—	—	8.22	1.65	27.3	—	—	—	—	—	—	—	—
	N obs.	6	6	0	—	—	—	—	6	6	6	1	1	—	0	0	0	0	0

Table E-1. Continued.

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1994 Near-bottom measurements:																			
M696.5D	Mean	1	1.2	—	—	—	—	—	14.3	9.55	95	449	8.3	—	—	—	—	—	—
	Median	1.05	1.26	—	—	—	—	—	18.9	8.9	94	449	8.3	—	—	—	—	—	—
	Minimum	0.5	0.75	—	—	—	—	—	1	7.1	50	449	8.3	—	—	—	—	—	—
	Maximum	1.3	1.5	—	—	—	—	—	24	12.8	134	449	8.3	—	—	—	—	—	—
	Std. dev.	0.32	0.3	—	—	—	—	—	10.4	2.35	34.2	—	—	—	—	—	—	—	—
	N obs.	6	6	0	—	—	—	—	6	6	6	1	1	—	0	0	0	0	0
1995 Near-surface measurements:																			
BK01.0M	Mean	0.2	3.1	—	93	12	43	0	12.3	12.1	114	244	8.3	—	8	13.4	5.4	13.6	—
	Median	0.2	3.1	—	100	10	40	0	10.6	12.1	94	254	8.1	—	7	7.7	5.2	7.48	—
	Minimum	0.2	3.1	—	80	1	0	0	0.3	5.6	56	131	7	—	3	2.5	1.9	-1	—
	Maximum	0.2	3.1	—	100	26	100	1	29.3	25	332	393	9.6	—	17	136	17.5	49.9	—
	Std. dev.	0	—	—	9.75	9.81	37	0.5	11	4.01	55.6	82.7	0.69	—	3.61	26.2	3.48	15.7	—
	N obs.	26	1	0	5	5	5	4	26	26	26	26	26	0	24	24	24	11	0
BK14.2M	Mean	0.2	—	—	—	—	—	—	11	9.96	89	143	7.6	—	11	17.1	4.5	5.13	—
	Median	0.2	—	—	—	—	—	—	9.45	10.1	87	151	7.6	—	8	13.8	4	2.41	—
	Minimum	0.2	—	—	—	—	—	—	-0.1	3.4	40	64	6.6	—	4	2.1	0.9	1.12	—
	Maximum	0.2	—	—	—	—	—	—	29.4	12.4	126	200	8.7	—	22	44.3	10.2	17.5	—
	Std. dev.	0	—	—	—	—	—	—	10.3	1.89	19.1	40.5	0.51	—	5.57	13.6	2.86	5.57	—
	N obs.	26	0	0	0	0	0	0	26	26	26	26	26	0	24	25	25	10	0
BX00.4M	Mean	0.2	0.65	—	95	13	51	2	12.2	9.99	91	479	8.2	—	22	52.6	5.5	2.65	—
	Median	0.2	0.65	—	95	13	51	2	12.2	10	92	480	8.3	—	19	34	4.4	2.55	—
	Minimum	0.2	0.65	—	90	5	1	0	0	7.8	75	465	8	—	6	8.1	1.7	-1	—
	Maximum	0.2	0.65	—	100	21	100	4	25.8	12.5	100	505	8.4	—	50	182	14.5	5.88	—
	Std. dev.	0	—	—	7.07	11.3	70	2.8	8.76	1.66	6.79	9.46	0.13	—	13.6	49.4	3.35	1.9	—
	N obs.	14	1	0	2	2	2	2	14	14	14	14	14	0	12	13	13	10	0
CC00.6M	Mean	0.2	1.05	—	95	11	60	1	9.92	10.3	89	493	8.2	68	32	74.2	7.6	1.38	—
	Median	0.2	1.05	—	100	10	90	0	9.95	10.2	90	496	8.2	68	18	40.8	5	1.46	—
	Minimum	0.2	1.05	—	80	6	0	0	-0.1	7.8	69	469	7.8	68	7	11.7	2	-1	—
	Maximum	0.2	1.05	—	100	18	99	2	24.7	13	98	517	8.4	68	210	609	47.3	2.25	—
	Std. dev.	0	—	—	8.66	5.22	50.1	1	8.06	1.67	7.08	12	0.15	—	42.2	118	8.99	0.95	—
	N obs.	26	1	0	5	5	5	4	26	26	26	26	26	1	24	25	25	10	0

Table E-1. Continued.

E-10

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1995 Near-surface measurements:																			
LX00.1M	Mean	0.2	—	—	100	22	80	0	11.5	11.1	100	346	8.3	—	22	41.5	7.8	30.4	—
	Median	0.2	—	—	100	22	80	0	9.7	11.6	94	345	8.3	—	23	38.1	9.5	25.2	—
	Minimum	0.2	—	—	100	22	80	0	-0.1	6.9	80	284	7.7	—	4	3.8	1	-1	—
	Maximum	0.2	—	—	100	22	80	0	27.5	13.4	134	454	9.1	—	49	101	16.5	109	—
	Std. dev.	0	—	—	—	—	—	—	9.97	1.74	16.7	33.6	0.37	—	12.9	26.8	4.39	34.5	—
	N obs.	26	0	0	1	1	1	1	26	26	26	26	26	0	24	24	24	10	0
M679.5V	Mean	0.2	1.11	0.14	99.9	27	63	4	11.5	12.1	107	465	8.5	54.8	15	23.3	6.2	30	3.56
	Median	0.2	0.94	0.1	100	29	95	3	9.7	11.4	102	484	8.5	49	18	25.8	6.5	28.3	3.56
	Minimum	0.2	0.67	0	99	11	0	0	0	6.9	79	344	8	31	3	1.5	2	3.37	3.56
	Maximum	0.2	2.4	0.46	100	39	100	13	28.7	20.5	155	551	9	110	31	50.1	11.3	65.9	3.56
	Std. dev.	0	0.46	0.11	0.35	8.52	48.3	4.7	10.6	3.2	19	61.9	0.24	20.5	9.13	16.6	3.02	18.6	—
	N obs.	26	26	26	8	8	8	7	26	26	26	26	26	19	26	25	25	26	1
M681.3B	Mean	0.2	—	—	—	—	—	—	11.8	12.1	108	464	8.4	—	18	28.1	6.4	18	—
	Median	0.2	—	—	—	—	—	—	9.9	11.7	103	479	8.4	—	18	25.9	5.9	20.6	—
	Minimum	0.2	—	—	—	—	—	—	0	6.5	80	336	7.9	—	3	1.8	1.6	4.7	—
	Maximum	0.2	—	—	—	—	—	—	29.7	19	149	560	8.9	—	45	78	12.4	35.1	—
	Std. dev.	0	—	—	—	—	—	—	10.8	3.03	19.6	67.5	0.22	—	13.7	23.5	3.4	9.83	—
	N obs.	26	0	0	0	0	0	0	26	26	26	26	26	0	24	25	25	9	0
M691.3B	Mean	0.19	0.92	0	100	28	77	3	12.5	12.9	116	432	8.4	49.5	15	18.8	9.3	42.8	14.8
	Median	0.2	0.89	0	100	32	100	2	10.1	12.9	112	400	8.6	49.5	15	17.4	9.1	33.9	14.8
	Minimum	0.1	0.57	0	100	5	1	0	0.2	6.3	49	319	7.4	30	3	2	1.9	5.24	14.8
	Maximum	0.2	1.47	0.02	100	41	100	13	32.5	23.5	167	686	9.3	77	38	55.4	18.6	114	14.8
	Std. dev.	0.03	0.21	0	0	12.3	40.7	4.1	10.7	4.52	28.8	95.6	0.45	14.7	10.9	15.1	5.43	30.6	—
	N obs.	26	26	26	9	9	9	9	26	26	26	26	26	20	26	25	25	26	1
M696.5D	Mean	0.19	1.06	0	98.9	32	64	4	12.1	11.7	110	469	8.3	58.7	12	14.6	6.1	30.6	1.26
	Median	0.2	0.95	0	100	36	100	3	10.2	11.9	105	477	8.4	59	11	12.6	5.9	26.7	1.26
	Minimum	0	0.46	0	90	4	0	0	0	4.9	50	348	7.5	30	3	1.7	1.6	-1	1.26
	Maximum	0.2	1.92	0.04	100	49	100	15	30.9	25	328	600	8.9	97	33	41.8	14.7	87.6	1.26
	Std. dev.	0.04	0.4	0.01	3.33	16.4	48.2	4.8	10.9	3.58	53	54.1	0.37	18.5	7.73	10.2	3.33	22	—
	N obs.	26	26	26	9	9	9	9	26	26	26	26	26	18	26	25	25	26	1
M701.1B	Mean	0.2	2.07	0.33	75	12	29	0	11.4	11.3	99	433	8.4	87.5	10	13.1	5	24.5	6.27
	Median	0.2	1.91	0.23	90	14	10	0	9.6	11.6	96	452	8.4	68	12	15.1	5.3	22.5	6.27
	Minimum	0.2	1.1	0.08	10	4	10	0	0	6.3	79	285	7.9	48	2	2.2	1	5.99	6.27
	Maximum	0.2	3.2	0.74	100	21	99	1	27.2	18	157	561	9.1	199	17	23.6	10.6	61	6.27
	Std. dev.	0	0.59	0.2	37.7	6.76	39.3	0.5	10.5	3.26	15.9	77.2	0.27	41.2	4.85	7.29	2.21	15.2	—
	N obs.	26	24	25	5	5	5	4	26	26	26	26	26	26	26	25	25	26	1

Table E-1. Continued.

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1995 Near-surface measurements:																			
M702.7T	Mean	0.2	—	—	99.9	13	83	4	11.8	10.8	93	299	8.1	—	9	11.1	4.6	5.77	—
	Median	0.2	—	—	100	11	90	2	10.1	10.5	92	330	8.1	—	8	8	4.1	4.37	—
	Minimum	0.2	—	—	99	2	20	0	0.1	2.9	35	83	7.1	—	3	2.1	1.7	-1	—
	Maximum	0.2	—	—	100	22	100	13	30.8	18.9	151	522	9.3	—	22	57.5	13.3	17.2	—
	Std. dev.	0	—	—	0.38	6.87	28.5	5.7	11.1	4.09	23.2	134	0.46	—	5.03	11	2.65	5.36	—
	N obs.	26	0	0	7	7	7	6	26	26	26	26	26	0	24	25	25	9	0
R000.1M	Mean	0.2	1.28	0.45	90	29	81	3	10.5	10.3	90	525	8.3	64.2	22	53.6	6.8	10.1	—
	Median	0.2	1.22	0.45	92.5	28	97	4	9.4	10.3	94	527	8.3	68	17	43.3	5.1	3.99	—
	Minimum	0.2	0.83	0.39	75	14	1	0	-0.1	7.7	64	462	7.9	15	4	9	1.9	1.12	—
	Maximum	0.2	1.97	0.51	100	44	100	6	26.7	13.4	105	558	8.8	94	170	340	41.7	34.4	—
	Std. dev.	0	0.33	0.08	10.5	10.3	39.3	2.2	9.39	1.52	9.98	20.8	0.2	24.9	31.6	66.4	7.87	12.4	—
	N obs.	26	17	2	6	6	6	6	26	26	26	26	26	11	26	25	25	10	0
UI02.9M	Mean	0.2	0.65	—	100	29	95	4	14.2	11.3	110	487	8.4	—	15	31.9	6.4	35.9	—
	Median	0.2	0.65	—	100	29	95	4	13.5	12	105	519	8.4	—	14	27	5	11.7	—
	Minimum	0.2	0.65	—	100	25	90	1	0	7.7	60	273	8.2	—	2	3	1.6	2.14	—
	Maximum	0.2	0.65	—	100	32	100	7	30.4	15.2	177	590	8.7	—	33	90.3	12.6	103	—
	Std. dev.	0	—	—	0	4.95	7.07	4.2	10.7	2.06	28.2	91.3	0.15	—	10.1	26.9	4.07	38.9	—
	N obs.	14	1	0	2	2	2	2	14	14	14	14	14	0	12	13	13	10	0
1995 Near-bottom measurements:																			
M691.3B	Mean	0.75	0.95	—	—	—	—	—	21.2	8.61	94	392	8.4	—	—	—	—	—	—
	Median	0.75	0.93	—	—	—	—	—	21.4	8.05	94	387	8.4	—	—	—	—	—	—
	Minimum	0.5	0.74	—	—	—	—	—	11.8	2.6	31	372	7.7	—	—	—	—	—	—
	Maximum	1	1.2	—	—	—	—	—	29.9	13.9	139	440	8.9	—	—	—	—	—	—
	Std. dev.	0.16	0.15	—	—	—	—	—	6.35	3.78	34	23.2	0.39	—	—	—	—	—	—
	N obs.	8	8	0	—	—	—	—	8	8	8	8	8	—	0	0	0	0	0
M696.5D	Mean	1.09	1.29	—	—	—	—	—	11.6	10.9	97	477	8.4	—	8	—	—	—	—
	Median	1.1	1.31	—	—	—	—	—	12.3	11.6	102	471	8.5	—	8	—	—	—	—
	Minimum	0.6	0.82	—	—	—	—	—	1	1.8	21	405	7.5	—	8	—	—	—	—
	Maximum	1.5	1.69	—	—	—	—	—	23.5	16.3	153	648	9	—	8	—	—	—	—
	Std. dev.	0.27	0.26	—	—	—	—	—	8.23	4.52	40	79.2	0.47	—	—	—	—	—	—
	N obs.	8	8	0	—	—	—	—	8	8	8	8	8	—	1	0	0	0	0

Table E-1. Continued.

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)	
E-12	1996 Near-surface measurements:																			
	BK01.0M	Mean	0.2	2.38	—	86.9	30	45	1	11.3	10.1	93	217	8.2	—	7	8.1	4.3	24.2	—
		Median	0.2	2.35	—	100	34	45	0	11.9	9.6	94	227	8.1	—	6	8.1	3.9	17	—
		Minimum	0.2	2.3	—	5	1	0	0	0	7.2	49	106	7.1	—	4	1.5	1.3	-1	—
		Maximum	0.2	2.5	—	100	58	100	5	27.2	18.3	183	324	9.6	—	13	20.9	11.4	112	—
		Std. dev.	0	0.1	—	33.3	21.2	41.4	1.9	9.83	2.4	30.9	67.9	0.66	—	2.77	4.39	2.33	27.8	—
		N obs.	25	3	0	8	8	8	7	25	25	25	25	25	0	25	25	25	24	0
	BK14.2M	Mean	0.2	—	—	97.5	10	43	3	10.6	9.85	89	139	7.7	—	8	12	3.6	13.1	—
		Median	0.2	—	—	97.5	10	43	3	10.4	10.1	92	143	7.6	—	8	9.3	3.1	6.24	—
		Minimum	0.2	—	—	95	3	0	0	-0.1	7.2	49	57	6.8	—	3	2.5	1.3	-1	—
		Maximum	0.2	—	—	100	17	85	6	24.8	12.3	139	197	8.9	—	13	31.6	10.6	64.5	—
		Std. dev.	0	—	—	3.54	9.9	60.1	4.2	9.24	1.49	21.9	43.8	0.54	—	3.1	8.59	2.29	18.9	—
		N obs.	24	0	0	2	2	2	2	24	24	24	24	24	0	24	24	24	23	0
	BX00.4M	Mean	0.2	—	—	100	14	35	1	9.2	10.9	94	481	8.2	—	14	31.2	3.9	3.3	—
		Median	0.2	—	—	100	14	20	0	10.1	10.9	95	476	8.2	—	11	24.2	3.4	2.62	—
		Minimum	0.2	—	—	100	1	0	0	0	8.6	77	457	7.7	—	4	4.2	1.9	-1	—
		Maximum	0.2	—	—	100	25	100	2	19.9	14.2	132	513	8.4	—	37	92.1	9.9	11.6	—
		Std. dev.	0	—	—	0	10.6	45.1	1	7.22	1.57	10.8	14	0.18	—	8.34	23.3	1.89	2.82	—
		N obs.	25	0	0	4	4	4	4	25	25	25	25	25	0	25	25	25	24	0
	CC00.6M	Mean	0.2	—	—	100	20	30	2	9.36	10.8	93	494	8.2	—	17	42	4.5	2.77	—
	Median	0.2	—	—	100	18	10	0	9.4	10.8	94	494	8.2	—	13	30	3.2	2.57	—	
	Minimum	0.2	—	—	100	7	0	0	-0.1	8.5	72	468	7.6	—	5	7.4	1.6	-1	—	
	Maximum	0.2	—	—	100	36	100	6	20.1	13.5	112	529	8.5	—	45	128	12.7	11.1	—	
	Std. dev.	0	—	—	0	12.6	46.9	3	7.48	1.42	9.89	13	0.18	—	11.6	34	3.04	2.36	—	
	N obs.	25	0	0	4	4	4	4	25	25	25	25	25	0	25	25	25	25	0	
LX00.1M	Mean	0.2	—	—	100	32	68	3	10.5	11.4	102	342	8.4	—	16	33.5	7	51.1	—	
	Median	0.2	—	—	100	32	68	3	11.4	11	97	346	8.2	—	17	33.6	8	33	—	
	Minimum	0.2	—	—	100	23	40	1	-0.1	7.8	66	270	7.3	—	4	7	1.5	-1	—	
	Maximum	0.2	—	—	100	41	95	4	23.8	16.3	167	401	9.2	—	35	81.6	13.5	211	—	
	Std. dev.	0	—	—	0	12.7	38.9	2.1	9.19	2.12	25.9	31	0.54	—	9.02	21.2	4.16	62.5	—	
	N obs.	25	0	0	2	2	2	2	25	25	25	25	25	0	25	25	25	25	0	
M679.5V	Mean	0.2	1	0.12	95.5	30	69	6	10.4	11.3	102	404	8.4	48.2	15	22.3	5.5	33.3	—	
	Median	0.2	0.96	0.09	100	34	95	4	7.3	11.6	97	389	8.3	47	14	21.8	4.8	17.4	—	
	Minimum	0.2	0.68	0	75	1	0	0	0	8.3	62	294	7.8	22	2	1.1	0.3	-1	—	
	Maximum	0.2	1.97	0.41	100	52	100	26	27.5	14	179	526	9.5	87	35	65.4	16.7	240	—	
	Std. dev.	0	0.31	0.1	9.56	16.1	40.9	8.1	10.4	1.76	30.5	62.7	0.49	15.1	9.77	19.1	4.21	49.8	—	
	N obs.	26	26	26	10	10	10	10	26	26	26	26	26	17	25	26	26	26	0	

Table E-1. Continued.

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1996 Near-surface measurements:																			
M681.3B	Mean	0.2	—	—	—	—	—	—	11.1	11.6	105	399	8.4	—	18	25	6	33.8	—
	Median	0.2	—	—	—	—	—	—	11.7	11.3	95	379	8.2	—	19	24.9	5.3	17.4	—
	Minimum	0.2	—	—	—	—	—	—	0	7.1	57	302	7.6	—	2	1.4	-0.1	-1	—
	Maximum	0.2	—	—	—	—	—	—	26.3	19.7	190	518	9.4	—	50	80	13	192	—
	Std. dev.	0	—	—	—	—	—	—	9.9	2.59	33.3	60	0.49	—	13.6	21.6	4.59	44.2	—
	N obs.	25	0	0	0	0	0	0	25	25	25	25	25	0	25	25	25	25	0
M691.3B	Mean	0.2	1	0.01	100	32	71	6	10.5	9.37	88	435	8.2	65.6	9	10.9	5.6	27.2	—
	Median	0.2	0.95	0	100	36	100	3	5.65	10.2	98	391	8.4	60.5	9	10	4.9	20.2	—
	Minimum	0.2	0.67	0	100	6	0	0	0.1	0	0	317	7.1	39	3	1.8	1.9	-1	—
	Maximum	0.2	1.9	0.05	100	47	100	24	27.7	17.9	157	682	9.1	110	21	26	12.7	66.6	—
	Std. dev.	0	0.24	0.01	0	13.5	42.4	7.6	10.5	4.6	47.2	101	0.6	19	5.4	7.14	3.07	22	—
	N obs.	28	28	26	11	12	11	10	28	28	28	28	28	18	28	28	26	28	0
M696.5D	Mean	0.2	1.13	0	97.5	38	67	7	10.7	10.4	96	430	8.3	60.8	15	18.4	15.1	28.5	—
	Median	0.2	1.02	0	100	42	100	2	7.1	11.3	94	430	8.3	52	9	9	5.1	21.5	—
	Minimum	0.2	0.7	0	75	4	0	0	0.2	3.5	24	280	7.5	29	3	1.6	0.8	-1	—
	Maximum	0.2	2.3	0.02	100	63	100	28	27.1	15.4	181	521	8.9	100	49	94.9	226	157	—
	Std. dev.	0	0.4	0.01	7.91	21.6	46.4	9	10.7	3.45	40.9	60.6	0.44	25.3	13.5	21.8	45.1	33.4	—
	N obs.	26	26	25	10	10	10	9	26	26	26	26	26	19	26	26	24	26	0
M701.1B	Mean	0.2	2.08	0.28	99	25	81	5	10.2	10.6	93	366	8.3	86	10	12.3	3.9	25	—
	Median	0.2	1.99	0.2	100	24	100	5	7.35	10.4	92	354	8.1	74	10	12.6	3.9	12.4	—
	Minimum	0.2	0.94	0.07	95	13	0	0	0	7.5	67	226	7.7	32	3	1.5	0.6	-1	—
	Maximum	0.2	3.35	0.88	100	33	100	12	24.7	13.3	128	495	9.3	178	19	33.9	10.3	194	—
	Std. dev.	0	0.61	0.2	2	7.09	40	4.3	10.2	1.73	17.9	64	0.42	39.8	4.79	8.45	2.21	39.4	—
	N obs.	26	26	26	6	6	6	6	26	26	26	26	26	25	25	26	25	26	0
M702.7T	Mean	0.2	—	—	88.9	19	60	4	11.4	9.94	91	236	8.1	—	8	9.9	3.9	20.4	—
	Median	0.2	—	—	100	14	90	1	12.4	9.95	91	268	8.1	—	7	6.5	3.2	7.74	—
	Minimum	0.2	—	—	1	1	0	0	0	6.2	42	80	7	—	3	1.9	1.1	-1	—
	Maximum	0.2	—	—	100	59	100	20	28.1	17.4	169	396	9.5	—	17	42.9	12.1	201	—
	Std. dev.	0	—	—	33	19.6	46.6	7.2	10.2	2.53	30.6	99.7	0.61	—	3.58	9.31	2.5	42.4	—
	N obs.	24	0	0	9	9	9	8	24	24	24	24	24	0	24	24	24	24	0
R000.1M	Mean	0.2	1.54	0.34	96.3	27	86	7	9.56	10.4	90	518	8.3	93.4	14	32.1	3.9	5.04	—
	Median	0.2	1.53	0.3	100	28	100	5	7.95	10.5	92	521	8.3	106	7	15.6	2.3	2.32	—
	Minimum	0.2	1	0.23	80	5	5	0	0	7.9	57	343	7.7	27	3	5.7	1.1	-1	—
	Maximum	0.2	2.27	0.52	100	46	100	18	24.4	13.1	148	580	8.6	160	67	182	14.8	43.1	—
	Std. dev.	0	0.47	0.13	7.44	16	33	6.1	9.32	1.49	17.6	45.4	0.23	46.8	16	41.3	3.38	8.66	—
	N obs.	26	12	4	8	8	8	8	26	26	26	26	26	8	26	26	25	26	0

Table E-1. Continued.

Sampling location	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1996 Near-surface measurements:																			
UI02.9M	Mean	0.2	—	—	99.8	26	89	2	10.3	10.8	95	534	8.2	—	14	31.4	4.9	10.7	—
	Median	0.2	—	—	100	24	93	2	11.8	10.6	96	534	8.2	—	8	13.8	3.3	5.36	—
	Minimum	0.2	—	—	99	18	70	0	-0.1	8.3	72	471	7.4	—	3	2.8	1.2	-1	—
	Maximum	0.2	—	—	100	37	99	5	22.8	14.1	122	594	8.5	—	67	150	16	48.7	—
	Std. dev.	0	—	—	0.5	8.58	12.9	2.1	8.59	1.4	13.8	35.3	0.23	—	16.9	36.6	4.04	12.9	—
	N obs.	25	0	0	4	4	4	4	25	25	25	25	25	0	25	25	25	24	0
1996 Near-bottom measurements:																			
M691.3B	Mean	0.88	1.04	—	—	—	—	—	13	7.84	80	431	8.1	—	—	—	—	—	—
	Median	0.85	0.96	—	—	—	—	—	12.3	8	90	388	8.4	—	—	—	—	—	—
	Minimum	0.6	0.85	—	—	—	—	—	0.6	1.8	13	329	7.1	—	—	—	—	—	—
	Maximum	1.7	1.9	—	—	—	—	—	27.4	15	157	590	9	—	—	—	—	—	—
	Std. dev.	0.26	0.24	—	—	—	—	—	10.4	4.17	49.7	88.7	0.61	—	—	—	—	—	—
	N obs.	18	18	0	—	—	—	—	18	17	17	17	18	—	0	0	0	0	0
M696.5D	Mean	1.04	1.23	—	—	—	—	—	13.1	9.72	93	430	8.2	—	—	—	—	—	—
	Median	1	1.21	—	—	—	—	—	12.9	9.4	95	439	8.2	—	—	—	—	—	—
	Minimum	0.5	0.7	—	—	—	—	—	0.5	5.7	41	280	7.4	—	—	—	—	—	—
	Maximum	2.1	2.3	—	—	—	—	—	26.9	13.8	136	534	8.8	—	—	—	—	—	—
	Std. dev.	0.5	0.5	—	—	—	—	—	10.4	2.52	31.1	64.9	0.45	—	—	—	—	—	—
	N obs.	11	11	0	—	—	—	—	11	11	11	11	11	—	0	0	0	0	0

Table E-2. Annual summaries (1993–1996) of chemical measurements at fixed sites grouped into near-surface (less than or equal to 0.2 m below the surface) and near-bottom (less than or equal to 0.2 m above the substrate) categories. Below-surface chemical samples are infrequently collected.

Sampling location	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1993 Near-surface measurements:													
B001.0N	Mean	2.93	0.07	0.8	0.13	0.068	3.88	29	2.38	—	—	—	—
	Median	1.69	0.05	0.52	0.11	0.064	3.1	34.6	2.3	—	—	—	—
	Minimum	0.99	-0.02	0.16	0.1	0.047	2.02	8.5	2.2	—	—	—	—
	Maximum	5.17	0.2	2.25	0.19	0.12	7.2	44	2.7	—	—	—	—
	Std. dev.	1.929	0.059	0.783	0.041	0.025	2.073	18.39	0.183	—	—	—	—
	N obs.	4	7	7	4	7	7	3	6	0	0	0	0
BK01.0M	Mean	2.28	0.07	0.94	0.16	0.07	5.19	31.1	2.78	—	—	9.36	—
	Median	2.29	0.05	0.81	0.15	0.047	5.39	30	2.74	—	—	8.71	—
	Minimum	1.29	-0.02	0.41	0.11	0.036	3.74	24.6	2.31	—	—	5.03	—
	Maximum	3.49	0.2	1.76	0.25	0.17	6.58	42.8	3.1	—	—	15.4	—
	Std. dev.	0.728	0.048	0.388	0.043	0.041	0.763	6.951	0.288	—	—	2.578	—
	N obs.	13	15	15	13	15	15	5	8	0	0	15	0
BK14.2M	Mean	1.78	0.05	0.64	0.18	0.084	4.41	14.9	2.46	—	—	7.58	—
	Median	1.59	0.05	0.68	0.17	0.076	4.74	12.8	2.42	—	—	7.05	—
	Minimum	1.06	-0.02	0.15	0.096	0.046	2.25	9.6	2.09	—	—	2.2	—
	Maximum	3.56	0.09	1.2	0.32	0.14	6.88	24.5	3.2	—	—	24.7	—
	Std. dev.	0.582	0.024	0.288	0.06	0.029	1.292	5.757	0.317	—	—	5.054	—
	N obs.	15	19	19	15	19	19	5	11	0	0	15	0
CC00.6M	Mean	1.84	0.06	0.91	0.19	0.057	5.73	62.1	1.87	—	—	6.57	—
	Median	1.7	0.06	0.9	0.13	0.054	5.72	59.6	1.4	—	—	6.54	—
	Minimum	0.83	-0.02	0.54	0.071	0.018	4.35	55.3	1.2	—	—	5.96	—
	Maximum	2.96	0.1	1.26	0.59	0.12	6.61	76.7	4	—	—	7.86	—
	Std. dev.	0.56	0.033	0.154	0.138	0.027	0.575	8.438	0.874	—	—	0.428	—
	N obs.	16	19	19	16	19	19	5	11	0	0	15	0
LX00.1M	Mean	2.49	0.07	1.14	0.19	0.06	5.07	42.7	2.09	—	—	10.1	—
	Median	2.21	0.06	1.08	0.19	0.046	4.8	42	2	—	—	9.5	—
	Minimum	1.11	-0.02	0.46	0.072	-0.01	3.28	29.9	1.6	—	—	5.78	—
	Maximum	5.79	0.2	2.04	0.3	0.14	7.2	55.8	2.8	—	—	17.5	—
	Std. dev.	0.99	0.059	0.44	0.071	0.037	1.023	8.749	0.396	—	—	2.656	—
	N obs.	17	22	22	17	22	22	8	14	0	0	15	0
M679.5V	Mean	3.58	0.05	2.68	0.18	0.095	6.56	64.1	2.53	—	—	15.2	—
	Median	3.69	0.04	2.67	0.18	0.086	6.46	59.6	2.4	—	—	14.7	—
	Minimum	1.03	-0.02	1.85	0.071	0.038	3.61	48	1.8	—	—	11.3	—
	Maximum	4.75	0.1	4.01	0.28	0.2	9.17	100	3.2	—	—	28.6	—
	Std. dev.	0.89	0.029	0.571	0.07	0.051	1.609	18.44	0.455	—	—	4.375	—
	N obs.	16	20	20	16	20	20	6	12	0	0	13	0

Table E-2. Continued.

Sampling location	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1993 Near-surface measurements:													
E-16 M681.3B	Mean	3.61	0.04	2.47	0.18	0.091	6.55	63.5	2.62	—	—	14.3	—
	Median	3.35	0.04	2.44	0.19	0.085	6.08	59.8	2.5	—	—	14.1	—
	Minimum	2.74	-0.02	1.83	0.071	0.03	3.05	55.8	2.09	—	—	10.8	—
	Maximum	5.18	0.1	3.67	0.27	0.19	9.64	77	3.3	—	—	17.4	—
	Std. dev.	0.794	0.03	0.515	0.066	0.054	1.788	8.447	0.407	—	—	1.925	—
	N obs.	14	16	16	14	16	16	5	10	0	0	14	0
	Mean	2.41	0.05	1.21	0.13	0.037	3.52	55.7	2.07	—	—	9.34	—
	Median	1.88	0.03	0.028	0.11	-0.01	2.7	53	2	—	—	8.41	—
	Minimum	1.19	-0.02	-0.01	0.047	-0.01	0.11	34.5	1.2	—	—	7.42	—
	Maximum	5.15	0.3	5.14	0.22	0.2	7.66	74.7	2.6	—	—	11.8	—
M691.3B	Std. dev.	1.283	0.061	1.837	0.057	0.055	2.492	15.43	0.426	—	—	1.861	—
	N obs.	16	19	19	16	19	19	5	11	0	0	12	0
M696.5D	Mean	3.13	0.06	1.6	0.15	0.074	5.94	57.1	2.48	—	—	11	—
	Median	2.6	0.05	1.44	0.14	0.04	5.96	58.1	2.8	—	—	12.3	—
	Minimum	1.06	-0.02	0.17	0.062	-0.01	0.54	48	1.2	—	—	6.37	—
	Maximum	9.61	0.3	3.74	0.27	0.22	8.38	64	3.4	—	—	15.4	—
	Std. dev.	2.014	0.062	1.044	0.067	0.067	2.091	6.215	0.735	—	—	3.138	—
	N obs.	15	19	19	15	19	19	5	11	0	0	13	0
M701.1B	Mean	3.2	0.06	2.1	0.16	0.097	6.43	49.8	2.83	—	—	13.1	—
	Median	3.05	0.06	1.99	0.18	0.097	6.3	49.5	2.9	—	—	13.4	—
	Minimum	1.36	-0.02	1.39	0.065	0.044	3.19	34.2	2	—	—	6.7	—
	Maximum	4.66	0.2	3.23	0.27	0.2	9.09	63.8	3.8	—	—	17.3	—
	Std. dev.	0.745	0.037	0.551	0.058	0.049	1.738	9.272	0.508	—	—	2.909	—
	N obs.	17	21	21	17	21	21	7	13	0	0	14	0
M702.7T	Mean	2.57	0.05	1.35	0.16	0.089	5.39	50.3	2.84	—	—	12.5	—
	Median	2.39	0.04	1.42	0.17	0.086	5.8	48.2	2.84	—	—	12.8	—
	Minimum	1.34	-0.02	0.25	0.048	0.043	2.37	41.4	2.4	—	—	3.42	—
	Maximum	4.17	0.1	2.49	0.3	0.17	8.38	67.3	3.4	—	—	21.7	—
	Std. dev.	0.769	0.039	0.601	0.057	0.036	1.76	10.28	0.316	—	—	4.635	—
	N obs.	15	19	19	15	19	19	5	11	0	0	15	0
R000.1M	Mean	5.29	0.04	4.46	0.16	0.072	6.35	76.6	1.6	—	—	9.98	—
	Median	5.17	0.03	4.14	0.14	0.063	6.23	73.8	1.42	—	—	10.1	—
	Minimum	3.72	-0.02	3.57	0.019	0.021	4.96	71.4	1.2	—	—	4.32	—
	Maximum	6.98	0.1	5.89	0.41	0.17	8.36	90	2.2	—	—	13.1	—
	Std. dev.	0.903	0.032	0.768	0.107	0.046	0.882	6.79	0.344	—	—	1.892	—
	N obs.	17	20	20	17	20	20	6	12	0	0	14	0

Table E-2. Continued.

Sampling location	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1994 Near-surface measurements:													
BK01.0M	Mean	1.52	0.1	0.81	0.14	0.035	4.44	30.1	2.69	12.2	6.88	9.74	20.1
	Median	1.49	0.04	0.74	0.11	0.035	4.85	28.8	2.46	11.3	5.84	9.22	15.3
	Minimum	0.96	-0.02	-0.01	0.062	-0.01	0.095	10.9	1.77	4.62	2.12	4.52	5.76
	Maximum	2.51	0.6	1.9	0.63	0.11	7.58	53.7	4.65	21.7	25.3	16.5	45.5
	Std. dev.	0.41	0.149	0.548	0.116	0.025	2.016	10.03	0.636	4.356	4.435	3.056	10.19
	N obs.	25	26	26	25	26	26	26	26	26	26	26	24
BK14.2M	Mean	1.53	0.1	0.84	0.18	0.043	4.26	16.8	2.5	6.91	4.51	8.23	11.3
	Median	1.32	0.02	0.7	0.12	0.036	4.25	15.6	2.22	6.71	3.08	5.71	8.16
	Minimum	0.94	-0.02	0.47	0.071	-0.01	0.97	6.62	1.5	2.42	1.87	2.7	3.46
	Maximum	5.01	0.9	1.51	0.6	0.25	7.12	34.7	4.62	13.7	28.9	50.9	64.2
	Std. dev.	0.78	0.231	0.312	0.14	0.046	1.552	6.016	0.846	2.377	5.181	9.189	12.05
	N obs.	26	26	26	26	26	26	26	26	26	26	26	24
CC00.6M	Mean	1.39	0.07	1.54	0.13	0.023	4.89	53.4	1.85	29.9	4.13	5.78	13.2
	Median	1.37	0.03	0.96	0.1	0.01	5.19	56.1	1.44	31.7	2.99	5.46	12
	Minimum	1.03	-0.02	0.77	0.033	-0.01	3.26	0.95	1.02	0.24	0.5	3.77	9.02
	Maximum	2.49	0.6	15.7	0.52	0.2	5.9	76.7	5.5	43	31.2	9.87	41.7
	Std. dev.	0.331	0.143	2.892	0.103	0.04	0.722	15.14	1.136	9.136	5.665	1.441	6.333
	N obs.	25	26	26	26	25	23	26	26	26	26	24	23
LX00.1M	Mean	1.88	0.1	1.15	0.22	0.047	4.4	36	2.84	17.6	5.45	8.6	16.2
	Median	1.69	0.03	1.08	0.16	0.037	4.84	35.8	2.13	17.9	4.32	8.29	13.4
	Minimum	1.25	-0.02	0.5	0.072	-0.01	2.13	20	1.44	9.97	3.07	4.65	9.69
	Maximum	3.7	1.2	2.1	0.77	0.26	6.76	47.7	11.9	23.5	28.3	13.4	79.3
	Std. dev.	0.653	0.247	0.429	0.184	0.058	1.393	6.532	2.306	3.613	4.979	1.851	13.86
	N obs.	24	24	24	24	24	23	24	24	24	24	24	23
M679.5V	Mean	2.38	0.04	1.66	0.14	0.037	5.09	52.9	2.74	21.2	9.28	12.1	39.1
	Median	2.42	-0.02	1.6	0.14	0.029	5.49	53	2.73	20.2	8.98	11.8	34
	Minimum	1.55	-0.02	0.58	0.059	-0.01	1.19	42.1	1.8	15.7	4.53	9.12	26.1
	Maximum	3.41	0.3	2.76	0.29	0.1	7.3	68.8	3.96	30.3	12.2	17.6	62
	Std. dev.	0.467	0.07	0.588	0.06	0.028	1.735	7.67	0.505	3.812	1.851	2.179	11.43
	N obs.	21	22	22	21	22	22	22	22	22	22	22	21
M681.3B	Mean	2.65	0.1	1.74	0.17	0.055	5.15	52.4	2.84	20.8	9.9	12.1	36.5
	Median	2.58	-0.02	1.8	0.14	0.038	5.62	52.2	2.55	21.1	9.28	12	35
	Minimum	1.77	-0.02	0.2	0.059	-0.01	1.94	25.3	1.77	8.03	5.28	6.02	14.3
	Maximum	5.75	1.2	2.67	0.5	0.33	7.37	75.1	8.47	29.6	25.1	16.9	63.5
	Std. dev.	0.818	0.249	0.599	0.099	0.066	1.444	10.11	1.279	4.715	3.757	2.454	11.91
	N obs.	25	25	25	25	25	25	25	25	25	25	25	23

Table E-2. Continued.

Sampling location	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1994 Near-surface measurements:													
M691.3B	Mean	1.18	0.08	0.39	0.09	0.018	1.75	42.6	2.82	22.6	5.22	8.19	33.3
	Median	1.07	-0.02	0.11	0.088	-0.01	1.57	41	2.49	20.9	4.88	8.13	16.6
	Minimum	0.56	-0.02	-0.01	0.022	-0.01	0.072	25.7	1.86	16.5	1.87	4.47	8.26
	Maximum	3.09	0.7	4.37	0.19	0.12	6.42	80.6	4.08	43.7	9.87	14.9	310
	Std. dev.	0.511	0.173	0.939	0.043	0.028	1.692	12.81	0.766	5.961	1.906	2.065	62.07
	N obs.	22	23	23	22	23	23	23	23	23	23	23	23
M696.5D	Mean	1.57	0.1	0.97	0.13	0.026	4.45	53.7	2.58	25.5	6.6	8.52	27.7
	Median	1.41	0.07	0.87	0.11	0.01	4.75	52	2.49	26.8	5.95	8.09	23.9
	Minimum	0.82	-0.02	0.11	0.026	-0.01	0.54	37.1	1	15.1	0.3	4.47	12.1
	Maximum	3.05	0.6	2.73	0.33	0.16	6.75	80.5	6.09	37.8	29.8	17.6	79.5
	Std. dev.	0.623	0.162	0.691	0.081	0.039	1.64	9.469	1.172	5.612	5.678	3.404	15.56
	N obs.	23	23	23	23	23	23	23	23	23	23	23	22
M701.1B	Mean	2.11	0.09	1.47	0.17	0.054	5.17	46.9	2.96	19	9.72	12.2	35.9
	Median	2.13	-0.02	1.41	0.14	0.039	5.7	45.8	2.79	18	9.11	10.8	33
	Minimum	0.96	-0.02	0.69	0.069	-0.01	1.49	30.4	1.83	12	4.49	6.2	23
	Maximum	3.72	0.6	2.52	0.46	0.15	7.07	74.6	4.62	28.6	24.1	24.9	66
	Std. dev.	0.55	0.168	0.505	0.09	0.042	1.756	10.14	0.641	4.597	3.861	4.373	11.6
	N obs.	23	24	24	23	24	23	24	24	24	24	24	23
M702.7T	Mean	1.79	0.1	1.07	0.16	0.046	4.51	32.8	2.86	14	7.46	9.44	30.4
	Median	1.54	0.03	0.89	0.12	0.046	5.29	31.9	2.7	13.2	6.4	8.72	23.4
	Minimum	0.68	-0.02	0.31	0.044	-0.01	0.42	13.1	1.74	4.7	2.24	4.11	8.35
	Maximum	5.97	0.5	2.33	0.49	0.11	7.43	63.8	4.71	35.7	24.7	19.2	166
	Std. dev.	1.022	0.158	0.532	0.1	0.029	1.908	13.78	0.699	7.191	4.753	3.917	32.79
	N obs.	24	24	24	24	24	23	24	24	24	24	24	23
R000.1M	Mean	3.52	0.05	3.14	0.12	0.02	5.29	69	1.75	25.6	5.32	8.17	14.3
	Median	3.46	-0.02	3.46	0.085	-0.01	5.46	68.8	1.56	25.8	4.14	8.36	14.8
	Minimum	2.54	-0.02	-0.01	0.031	-0.01	3.33	43.4	0.96	13.8	0.2	2.2	2.94
	Maximum	4.95	0.4	4.8	0.61	0.17	7.23	91.1	5.58	32.6	28.7	10.7	17.7
	Std. dev.	0.559	0.092	1.053	0.121	0.034	1.126	10.59	0.895	3.676	5.36	1.789	3.095
	N obs.	23	23	23	23	23	22	23	23	23	23	23	22

Table E-2. Continued.

Sampling location	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1995 Near-surface measurements:													
E-19 BK01.0M	Mean	1.52	0.07	0.66	0.11	0.037	4.81	28.7	2.69	12.3	5.94	9.04	19.5
	Median	1.41	0.05	0.58	0.08	0.032	5.22	28.6	2.58	12.1	5.56	8.09	15.6
	Minimum	0.65	-0.02	-0.01	0.036	-0.01	0.96	13.3	1.17	4.95	1.9	4.96	6.84
	Maximum	2.45	0.3	1.56	0.39	0.11	7.09	55	8.1	33.3	10.9	13.1	42.7
	Std. dev.	0.42	0.069	0.559	0.074	0.03	1.713	12.14	1.239	6.513	2.59	2.376	10.37
	N obs.	26	26	26	26	26	26	26	26	26	26	26	26
	Mean	1.7	0.06	0.68	0.12	0.049	4.78	16.9	2.81	7.53	3.29	5.77	8.41
	Median	1.3	0.04	0.53	0.12	0.044	4.76	15.2	2.22	6.58	3.37	5.86	8.42
	Minimum	0.78	-0.02	0.089	0.049	-0.01	2.59	7.55	0.96	2.87	1.02	3.27	3.92
	Maximum	10.3	0.3	1.4	0.27	0.15	7.08	55	13.2	33.4	6.07	8.23	11.8
BX00.4M	Std. dev.	1.795	0.077	0.396	0.058	0.032	1.407	9.459	2.289	5.83	1.08	1.124	2.12
	N obs.	26	26	26	26	26	25	26	26	26	26	25	25
	Mean	1.56	0.07	1.04	0.086	0.01	5.52	55.9	1.29	33.7	2.72	4.39	10.6
	Median	1.58	0.05	0.96	0.082	-0.01	5.54	56	1.2	33.8	2.48	4.38	10.4
	Minimum	1.23	0.03	0.82	0.026	-0.01	5	49.8	0.99	29.6	1.05	3.34	8.95
	Maximum	1.81	0.1	1.47	0.19	0.029	6.18	61.9	1.8	38.3	4.54	5.61	11.7
	Std. dev.	0.165	0.035	0.213	0.045	0.008	0.366	3.446	0.252	2.451	1.189	0.527	0.874
	N obs.	14	14	14	14	14	14	14	14	14	14	14	14
	Mean	1.4	0.06	0.92	0.13	0.014	5.74	57.2	1.74	32.8	3.17	5.52	12.3
	Median	1.33	0.05	0.88	0.07	0.012	5.83	57.6	1.44	33	3.28	5.52	12.2
CC00.6M	Minimum	0.98	0.03	0.73	0.027	-0.01	3.99	36	0.54	18.6	1.3	0.7	1.33
	Maximum	2.31	0.2	1.16	0.71	0.04	7.16	68.3	4.56	37.5	5.64	7.41	14.9
	Std. dev.	0.297	0.036	0.143	0.153	0.011	0.578	5.918	0.951	3.765	1.021	1.173	2.495
	N obs.	26	26	26	26	26	26	26	26	26	26	26	26
	Mean	1.79	0.07	1.16	0.13	0.036	5.53	39.9	2.21	19.9	4.97	9.6	16.5
	Median	1.81	0.04	1.1	0.13	0.035	5.66	38.9	2.1	18.9	4.61	9.17	14.1
	Minimum	1.14	-0.02	0.11	0.038	-0.01	3.22	29.5	0.84	15.3	2.58	6.19	10.4
	Maximum	2.41	0.3	2.05	0.25	0.07	7.13	60.9	4.08	30.2	12	20.9	73.4
	Std. dev.	0.283	0.065	0.501	0.058	0.017	1.044	6.875	0.734	3.208	1.808	2.594	11.74
	N obs.	26	26	26	26	26	26	26	26	26	26	26	26
M679.5V	Mean	2.75	0.05	1.97	0.11	0.044	5.42	58.2	2.97	23.8	11.3	14.3	46.3
	Median	2.77	0.04	2.08	0.093	0.039	5.41	61.5	2.88	25	11	14.2	49.1
	Minimum	1.48	-0.02	0.34	0.047	-0.01	-0.05	40.5	1.92	16.3	6.21	5.12	20.2
	Maximum	4.02	0.1	3.44	0.29	0.085	8.43	85	4.9	37.9	17.7	22.2	72.3
	Std. dev.	0.628	0.03	0.766	0.055	0.025	2.034	11.08	0.679	5.233	3.523	3.284	16.88
	N obs.	26	26	26	26	26	25	26	26	26	26	25	24

Table E-2. Continued.

Sampling location	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1995 Near-surface measurements:													
M681.3B	Mean	2.77	0.05	1.96	0.11	0.045	5.77	56.4	2.56	23.6	10.1	13.1	42
	Median	2.7	0.04	2.08	0.084	0.041	5.95	55.8	2.49	23.3	10.5	13.3	34.9
	Minimum	1.49	-0.02	0.49	0.037	-0.01	1.65	40.5	1.38	15.3	4.25	-0.01	-0.01
	Maximum	3.86	0.3	3.25	0.22	0.11	8.54	70	4.68	33.7	15	18.7	77.4
	Std. dev.	0.624	0.054	0.728	0.058	0.029	1.589	8.708	0.691	4.701	2.62	3.503	18.95
	N obs.	26	26	26	26	26	26	26	26	26	26	26	26
	Mean	1.67	0.05	0.3	0.097	0.008	2.03	51.8	2.57	27.7	7.26	9.8	23.8
	Median	1.53	0.03	-0.01	0.088	-0.01	1.57	43.9	2.37	25.9	6.88	9.34	23.8
	Minimum	0.77	-0.02	-0.01	0.027	-0.01	-0.05	35.5	1.59	17.4	4.46	5.09	10.9
	Maximum	4.23	0.5	2.16	0.26	0.028	7.49	92.2	4.05	49.6	13.1	14.9	51
M691.3B	Std. dev.	0.77	0.093	0.551	0.065	0.005	1.918	16.22	0.739	8.072	2.103	2.379	8.561
	N obs.	26	26	26	26	26	26	26	26	26	26	26	26
M696.5D	Mean	1.88	0.07	1.01	0.092	0.025	4.95	57.5	2.91	27.9	9.64	12.7	28.8
	Median	1.54	0.06	0.9	0.08	0.02	4.68	56.6	2.61	28.1	8.75	11.1	24.7
	Minimum	-0.1	-0.02	0.035	0.028	-0.01	0.72	41.8	1.26	16.1	2.31	0.76	1.91
	Maximum	6.68	0.2	2.27	0.2	0.096	8.37	79	4.6	40.5	28.7	45.5	74
	Std. dev.	1.215	0.049	0.612	0.048	0.024	1.872	9.757	0.951	6.8	5.681	9.555	18.3
	N obs.	26	26	26	26	26	26	26	26	26	26	26	26
M701.1B	Mean	2.51	0.06	1.68	0.13	0.06	5.97	51.9	3.22	21.4	11.6	14.5	48.5
	Median	2.47	0.06	1.8	0.094	0.059	6.66	53.5	2.91	22.4	10.8	14.3	44.9
	Minimum	1.53	-0.02	0.3	0.044	-0.01	2.2	35.3	2.1	13.6	5.64	5.39	20.4
	Maximum	3.61	0.3	3.02	0.75	0.12	8.86	84.1	5.8	37.7	21.3	21.9	76.9
	Std. dev.	0.536	0.051	0.643	0.133	0.036	1.918	11.9	0.938	5.671	4.153	3.794	19.08
	N obs.	26	26	26	26	26	25	25	25	25	25	25	25
M702.7T	Mean	1.85	0.06	1.06	0.11	0.059	5.36	33.1	3.03	13.6	7.26	10.4	29
	Median	1.82	0.05	1.02	0.093	0.045	6.03	34.7	2.76	13.1	6.28	9.84	26.5
	Minimum	0.77	-0.02	0.091	0.042	-0.01	1.96	8.26	1.26	3.17	2.15	3.84	4.02
	Maximum	2.91	0.3	2.11	0.29	0.2	8.51	57.8	9.78	25.8	14.6	16.8	73.7
	Std. dev.	0.565	0.065	0.621	0.06	0.047	1.953	16.82	1.502	7.331	3.767	3.853	19.35
	N obs.	26	26	26	26	25	25	25	26	26	26	25	25
R000.1M	Mean	3.93	0.04	3.77	0.091	0.014	5.49	73.7	1.96	27.4	4.5	9.55	16.7
	Median	3.69	0.03	3.72	0.069	0.012	5.66	72	1.65	27.3	4.5	9.42	16.1
	Minimum	2.8	-0.02	2.35	0.024	-0.01	1.73	61.8	1.17	18.9	2.06	7.39	13.6
	Maximum	6.88	0.1	5.72	0.32	0.033	7.97	97	4.47	36.8	8.11	12.9	31.7
	Std. dev.	0.869	0.026	0.859	0.073	0.009	1.455	8.114	0.937	3.689	1.349	1.214	3.361
	N obs.	25	26	26	25	26	26	26	26	26	26	26	26

Table E-2. Continued.

Sampling location	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1995 Near-surface measurements:													
UI02.9M	Mean	3.2	0.04	2.85	0.074	0.012	4.79	68.3	1.92	27	5.09	10.1	18.7
	Median	2.92	0.03	2.66	0.066	-0.01	4.58	72	1.8	27.3	4.85	9.76	17.8
	Minimum	2.59	-0.02	1.7	0.032	-0.01	2.9	11.1	1.2	5.02	3.05	8.06	16.1
	Maximum	4.51	0.1	4	0.13	0.048	6.26	89	3.3	37.6	7.99	12.3	23.7
	Std. dev.	0.565	0.029	0.869	0.034	0.013	1.046	17.96	0.56	7.027	1.262	1.228	2.119
	N obs.	14	14	14	14	14	14	14	14	14	14	14	14
1996 Near-surface measurements:													
BK01.0M	Mean	1.25	0.2	0.55	0.096	0.04	3.8	21	3.35	8.46	4.38	9.46	11.7
	Median	1.12	0.09	0.46	0.091	0.042	3.79	20.2	2.94	8.24	4.61	10.2	10.8
	Minimum	0.35	-0.02	-0.01	0.033	-0.01	0.69	10.7	2.01	4.11	-0.01	4.07	5.62
	Maximum	2.13	0.6	1.38	0.18	0.1	7.29	35	5.61	14.9	8.03	15.3	24.5
	Std. dev.	0.546	0.174	0.495	0.037	0.024	2.09	6.872	1.046	2.978	1.717	2.878	4.942
	N obs.	25	20	25	15	25	24	25	25	25	25	24	24
BK14.2M	Mean	1.26	0.1	0.67	0.11	0.041	4.16	13	3.23	5.45	2.05	6.25	6.79
	Median	1.11	0.04	0.65	0.1	0.033	4.36	12.8	2.82	5.45	1.92	6.44	7.19
	Minimum	0.79	-0.02	0.21	0.054	0.012	1.65	5.91	2.07	2.36	-0.01	4.1	3.35
	Maximum	2.28	0.7	1.31	0.16	0.12	7.28	22.2	6.51	8.76	3.89	8.88	9.89
	Std. dev.	0.39	0.175	0.275	0.029	0.024	1.586	4.645	1.078	1.929	1.248	1.204	1.858
	N obs.	24	19	24	14	24	23	24	24	24	24	23	23
BX00.4M	Mean	1.32	0.06	1.03	0.18	0.008	4.89	55.6	1.72	31.8	1.94	5.71	9.24
	Median	1.25	0.04	0.96	0.056	-0.01	4.91	59.4	1.68	32.4	1.79	5.07	8.59
	Minimum	-0.1	-0.02	0.25	0.031	-0.01	3.02	27	1.2	17.1	-0.01	4.17	7.57
	Maximum	2.82	0.2	1.86	2.05	0.026	6.07	68.8	2.55	39.7	11.7	20.4	11.4
	Std. dev.	0.542	0.042	0.329	0.498	0.006	0.82	10.14	0.384	5.127	2.228	3.167	1.17
	N obs.	25	20	25	16	25	24	25	25	25	25	24	24
CC00.6M	Mean	1.48	0.06	0.91	0.081	0.009	5.23	57.1	1.71	32.1	2.52	6.18	10.5
	Median	1.36	0.05	0.9	0.059	-0.01	5.29	59.7	1.77	31.8	2.37	6.05	10.2
	Minimum	0.92	-0.02	0.67	0.024	-0.01	3.56	28.2	1.02	16.9	-0.01	-0.01	-0
	Maximum	4.31	0.2	1.39	0.24	0.028	6.53	69.8	2.1	39.9	7.07	12.9	13.6
	Std. dev.	0.683	0.049	0.173	0.053	0.007	0.753	10.1	0.291	5.191	1.89	2.002	2.652
	N obs.	25	21	25	15	25	24	25	25	25	25	24	24

Table E-2. Continued.

Sampling location	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1996 Near-surface measurements:													
LX00.1M	Mean	1.61	0.1	1.05	0.15	0.026	5.02	38	2.58	18.7	4.02	10.6	12.1
	Median	1.52	0.05	1.05	0.14	0.024	5.38	40.4	2.43	19.1	3.86	9.99	11.4
	Minimum	0.52	-0.02	0.19	0.046	-0.01	1.97	15.9	1.71	9.61	-0.01	8.49	9.74
	Maximum	2.88	0.4	1.93	0.54	0.084	7.32	47.4	3.96	23.7	12.4	23.2	18.1
	Std. dev.	0.449	0.112	0.509	0.115	0.019	1.461	7.829	0.544	3.55	2.28	2.819	1.997
	N obs.	25	20	25	15	25	24	25	25	25	25	24	24
M679.5V	Mean	2.07	0.1	1.33	0.1	0.047	4.87	46.4	3.09	18.2	7.78	13.4	28.5
	Median	1.97	0.1	1.22	0.092	0.036	5.15	43.6	2.97	16.6	7.96	13.5	24.9
	Minimum	0.9	-0.02	-0.01	0.046	-0.01	2.01	18.8	1.8	7.44	4.75	8.6	15.5
	Maximum	3.3	0.4	2.81	0.16	0.18	7.83	77.4	4.83	30.9	11.6	17.2	53
	Std. dev.	0.721	0.124	0.871	0.037	0.039	1.814	12.67	0.761	5.296	2.042	1.843	9.811
	N obs.	26	21	25	19	25	23	26	26	26	26	23	23
M681.3B	Mean	1.92	0.1	1.32	0.11	0.039	4.97	45.6	3.08	17.7	7.46	13.5	28.1
	Median	1.63	0.05	1.4	0.095	0.039	5.2	42.8	3.06	16.1	7.52	13.6	24.6
	Minimum	-0.1	-0.02	-0.01	0.054	-0.01	2.2	19.1	1.68	7.75	4.8	8.64	16.2
	Maximum	3.79	0.3	2.85	0.18	0.094	7.9	67	4.47	27.3	11.1	17.4	49.8
	Std. dev.	0.887	0.104	0.875	0.038	0.024	1.772	11.91	0.645	4.866	1.936	2.302	9.795
	N obs.	25	20	25	16	25	24	25	25	25	25	24	24
M691.3B	Mean	1.43	0.2	0.41	0.071	0.011	3	48.4	2.99	23.6	4.85	10.3	17.7
	Median	1.26	0.06	0.099	0.069	-0.01	2.98	45.2	2.88	21.8	4.65	9.8	16.2
	Minimum	0.69	-0.02	-0.01	0.022	-0.01	-0.05	17.7	1.5	10.7	-0.01	5.23	5.32
	Maximum	2.36	0.6	2.36	0.16	0.036	6.6	97.4	5.31	43.8	10.4	16.7	40.7
	Std. dev.	0.496	0.19	0.643	0.037	0.011	1.997	19.12	0.832	8.88	2.762	2.719	7.078
	N obs.	26	21	25	18	25	22	26	26	26	26	22	22
M696.5D	Mean	1.7	0.2	0.81	0.1	0.028	4.96	47.3	2.87	22.3	5.39	10.1	19
	Median	1.38	0.1	0.58	0.082	0.017	5.55	45.7	2.91	21.2	5.32	10.6	16.1
	Minimum	0.55	-0.02	-0.01	0.014	-0.01	1.93	23.9	1.02	12.1	-0.01	4.63	6.85
	Maximum	4.22	0.9	2.84	0.38	0.11	8.89	70.2	5.34	35.2	13.7	19.4	37.5
	Std. dev.	0.949	0.219	0.771	0.087	0.028	1.632	12.17	0.978	6.735	3.907	4.066	7.742
	N obs.	26	21	25	19	25	23	26	26	26	26	23	23
M701.1B	Mean	1.75	0.1	1.13	0.1	0.054	4.86	39.9	3.17	15.9	7.58	13.1	27.6
	Median	1.75	0.09	1.12	0.092	0.058	5.35	36.8	3.09	14.9	7.14	13.5	24.2
	Minimum	-0.1	-0.02	-0.01	0.047	-0.01	1.76	18	2.1	7.09	4.08	3.35	8.91
	Maximum	2.96	0.5	2.43	0.18	0.1	7.64	82.3	5.67	35.6	12.1	17.2	54.6
	Std. dev.	0.719	0.133	0.714	0.034	0.028	1.66	13.87	0.812	6.24	2.28	3.35	11.17
	N obs.	26	21	25	19	25	23	26	26	26	26	23	23

Table E-2. Continued.

Sampling location	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1996 Near-surface measurements:													
M702.7T	Mean	1.38	0.1	0.76	0.1	0.057	4.23	23.2	3.3	9.26	5.06	9.93	15.8
	Median	1.23	0.06	0.62	0.088	0.05	3.98	24.4	2.91	9.71	5.12	10.8	15.2
	Minimum	0.73	-0.02	-0.01	0.046	-0.01	1.69	5.37	2.1	2.11	1.56	4.71	4.01
	Maximum	2.39	0.7	2.9	0.16	0.13	7.4	46	6.45	19.8	9.15	14.7	40.4
	Std. dev.	0.507	0.163	0.649	0.033	0.031	1.815	10.72	1.053	4.554	2.298	3.098	8.873
	N obs.	24	19	24	14	24	23	24	24	24	24	23	23
R000.1M	Mean	3.35	0.07	3.13	0.074	0.017	5.3	70.9	2.18	25.6	3.08	9.35	13.4
	Median	3.03	0.03	3.13	0.061	-0.01	5.38	74.2	2.07	26.1	2.99	8.99	13
	Minimum	1.98	-0.02	1.59	0.026	-0.01	1.65	28.5	1.08	13.3	-0.01	7.49	10.7
	Maximum	6.69	0.6	4.54	0.26	0.059	7.39	95.7	4.05	31.9	7.22	12.6	17.1
	Std. dev.	1.112	0.118	0.814	0.051	0.017	1.419	14.58	0.668	4.535	1.744	1.201	1.746
	N obs.	26	21	25	18	25	23	26	26	26	26	23	23
UI02.9M	Mean	3.3	0.05	3.23	0.1	0.021	4.34	72.3	2.8	24.9	3.39	10.9	16
	Median	2.82	0.02	2.92	0.083	0.013	4.21	72.1	2.58	25.8	3.43	10.3	15.3
	Minimum	0.38	-0.02	1.5	0.012	-0.01	0.96	30.4	1.53	14.2	-0.01	9.04	12.9
	Maximum	8.65	0.2	6.82	0.24	0.067	6.61	90.5	7.35	32.6	6.58	14.5	20.6
	Std. dev.	1.621	0.046	1.301	0.069	0.021	1.782	13.34	1.163	4.085	1.667	1.524	2.039
	N obs.	24	20	25	15	25	24	25	25	25	25	24	24

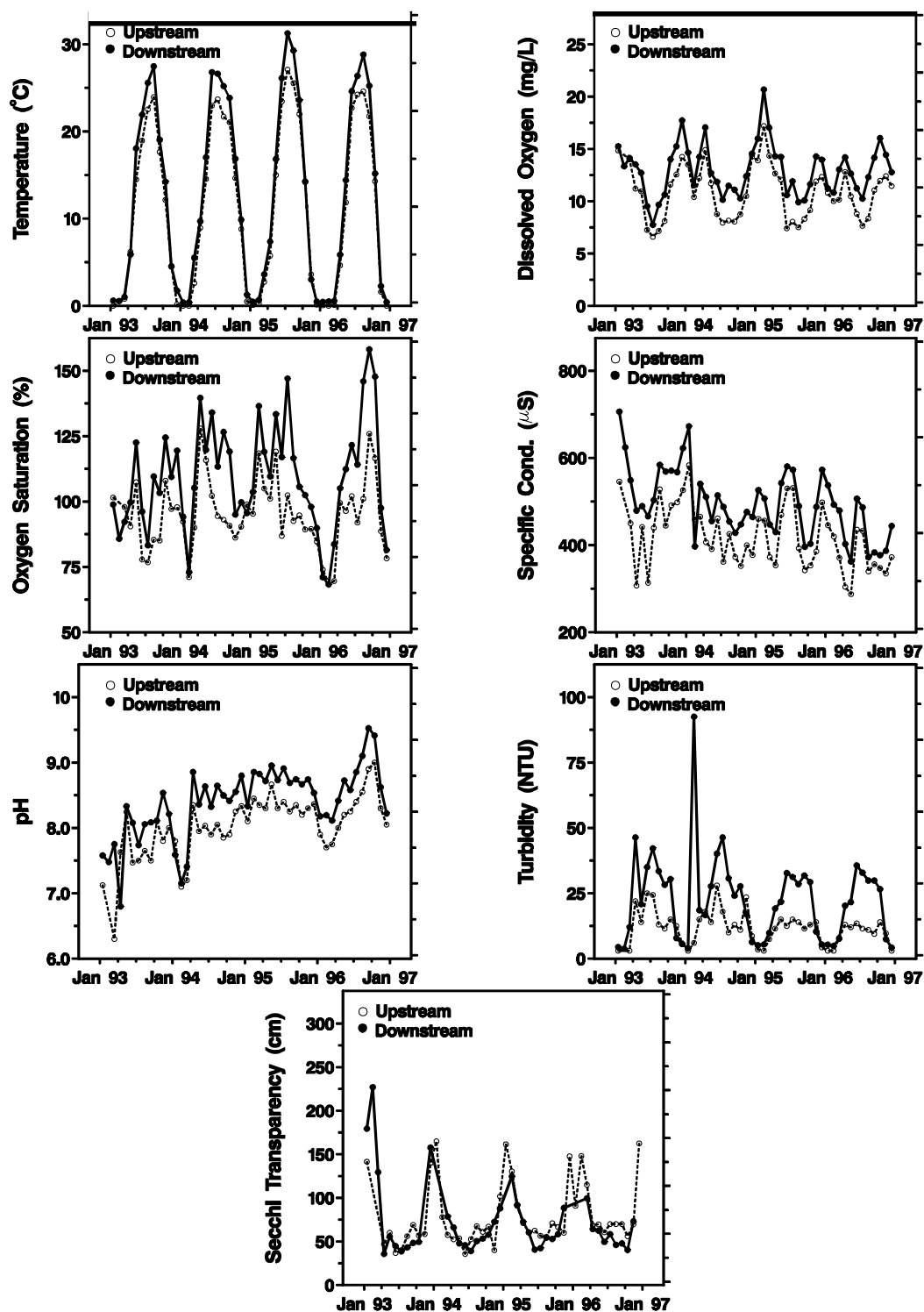


Figure E-1a. Monthly means of temperature (°C), dissolved oxygen (mg/L), oxygen saturation (%), pH, specific conductivity (μS), turbidity (NTU), and Secchi transparency (cm) at sites in upper and lower Pool 8 from 1993 through 1996.

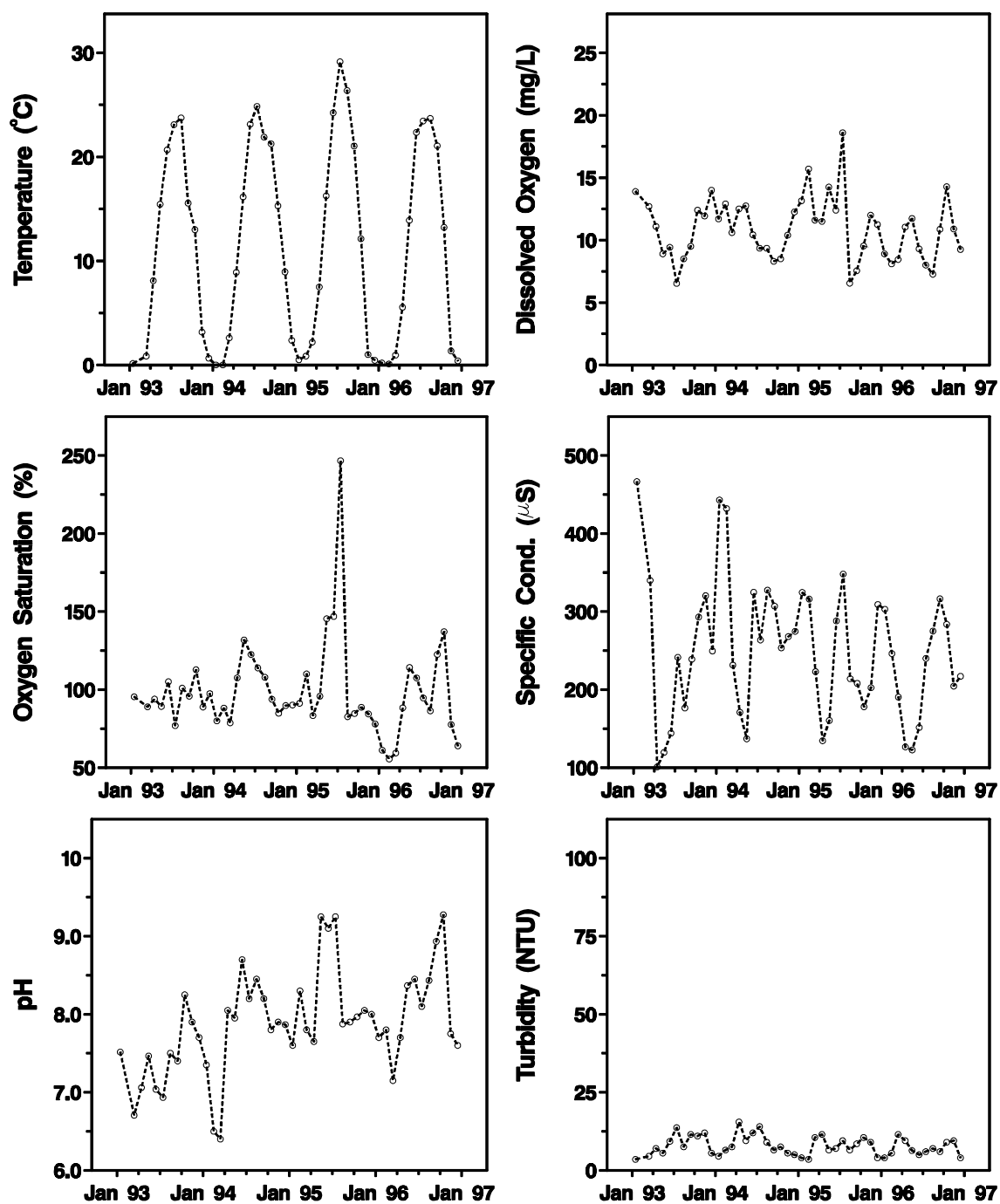


Figure E-1b. Monthly means of temperature (° C), dissolved oxygen (mg/L), oxygen saturation (%), pH, specific conductivity (μS), and turbidity (NTU) in the Black River (sites B001.0N and BK01.0M) from 1993 through 1996.

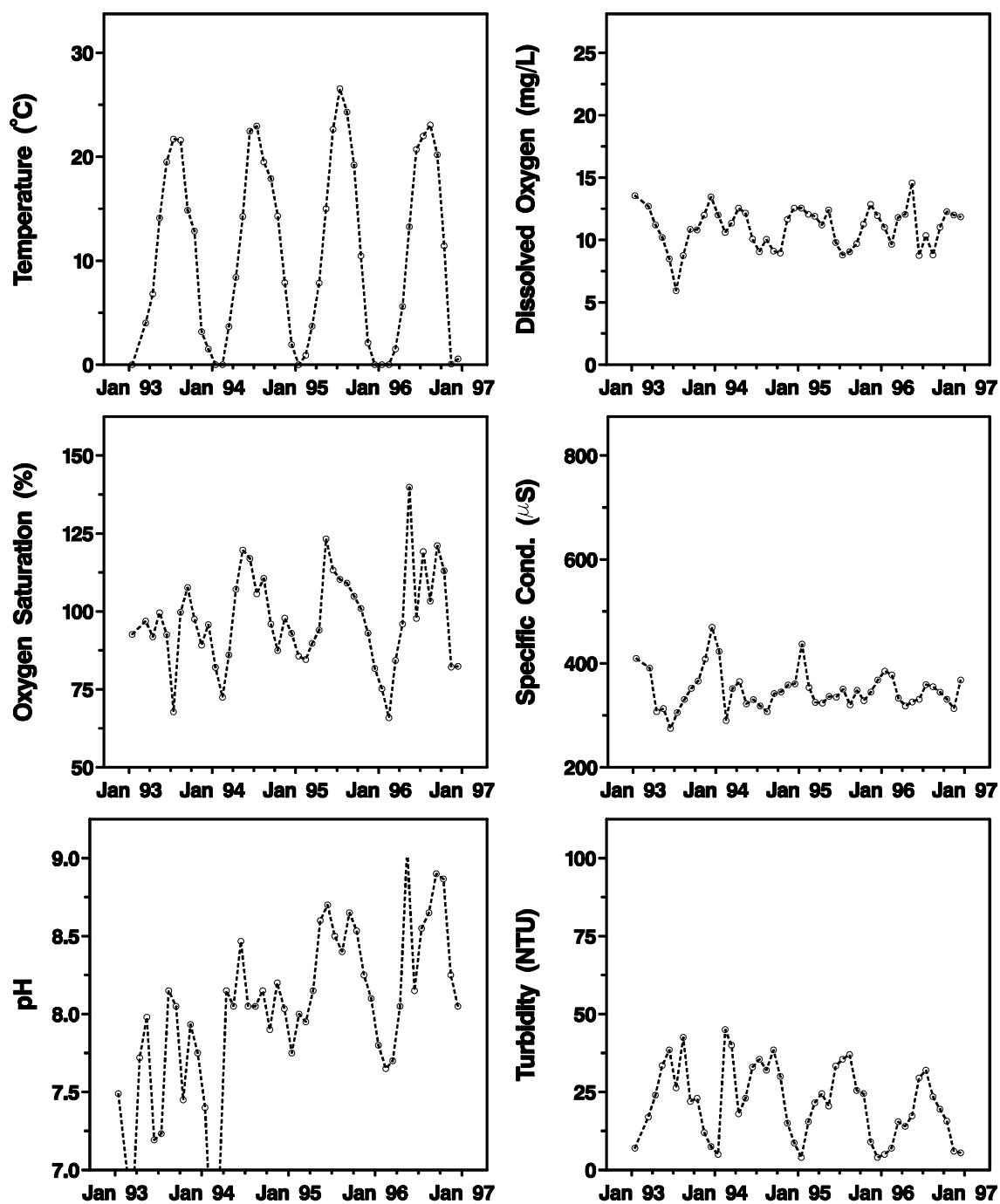


Figure E-1c. Monthly means of temperature (°C), dissolved oxygen (mg/L), oxygen saturation (%), pH, specific conductivity (μS), and turbidity (NTU) in the La Crosse River from 1993 through 1996.

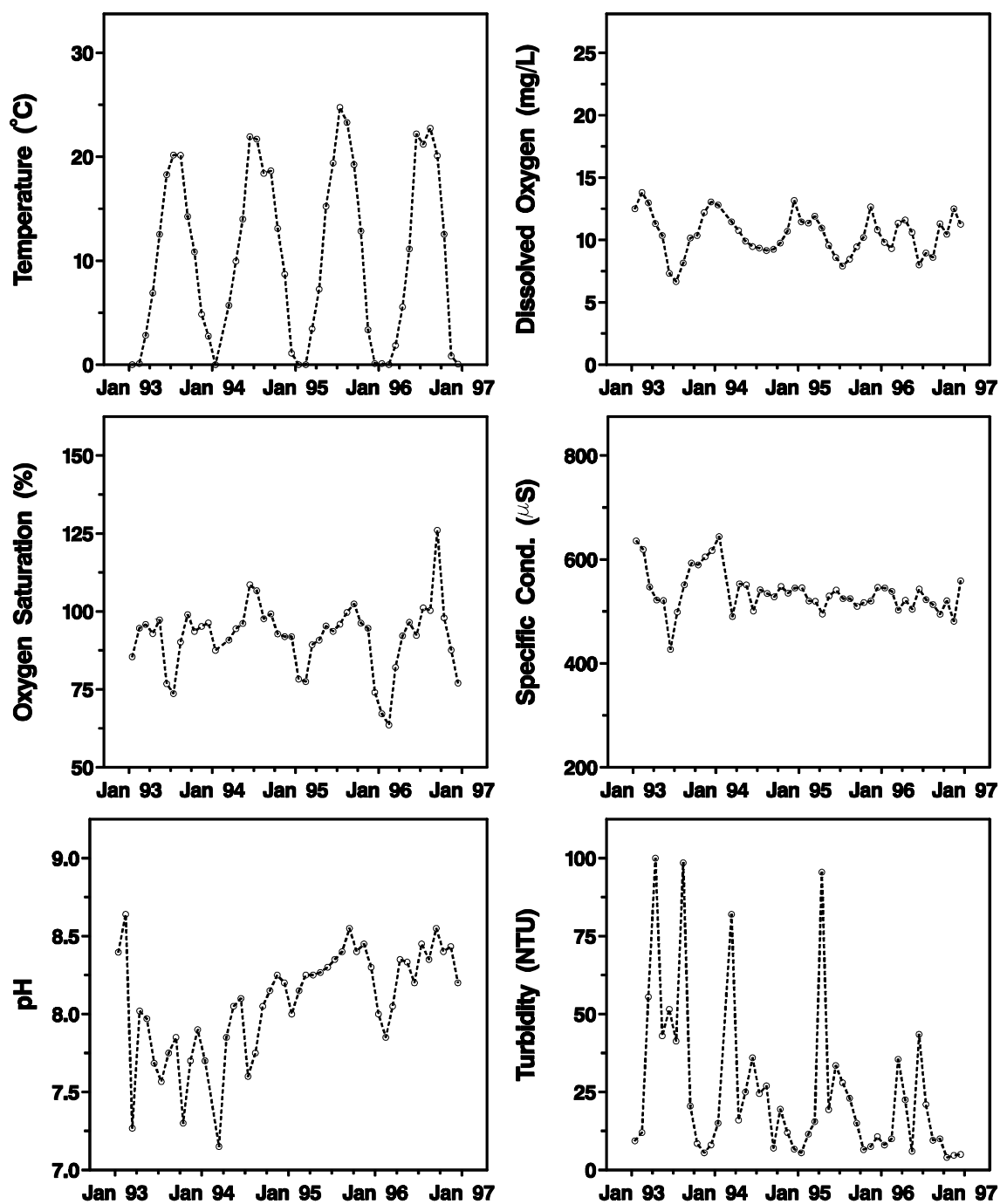


Figure E-1d. Monthly means of temperature (°C), dissolved oxygen (mg/L), oxygen saturation (%), pH, specific conductivity (μS), and turbidity (NTU) in the Root River from 1993 through 1996.

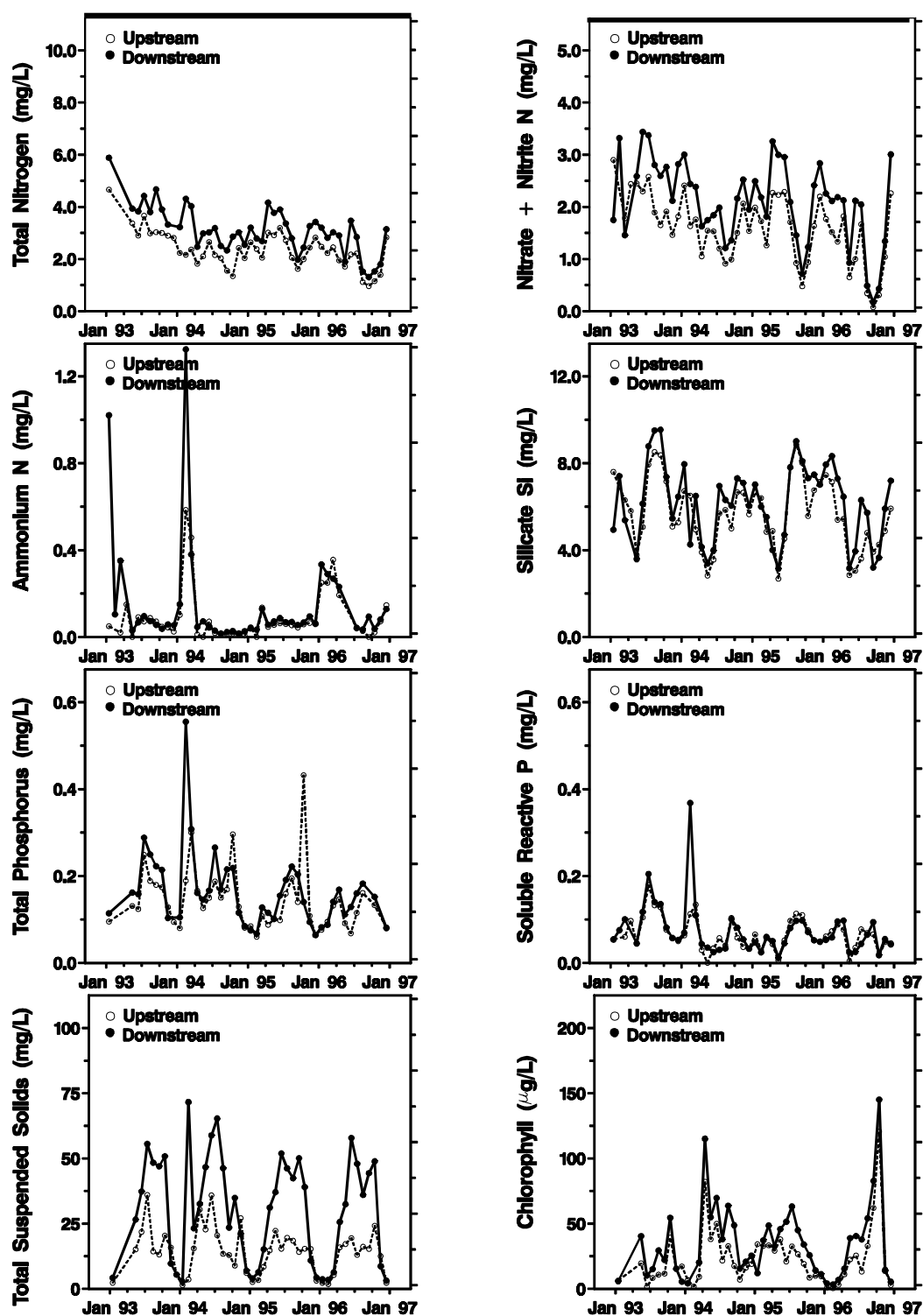


Figure E-2a. Monthly means of total nitrogen (mg/L), nitrate–nitrite nitrogen (mg/L), ammonium nitrogen (mg/L), silicate silicon (mg/L), total phosphorus (mg/L), soluble reactive phosphorus (mg/L), total suspended solids (mg/L), and chlorophyll a (μ g/L) at sites in upper and lower Pool 8 from 1993 through 1996.

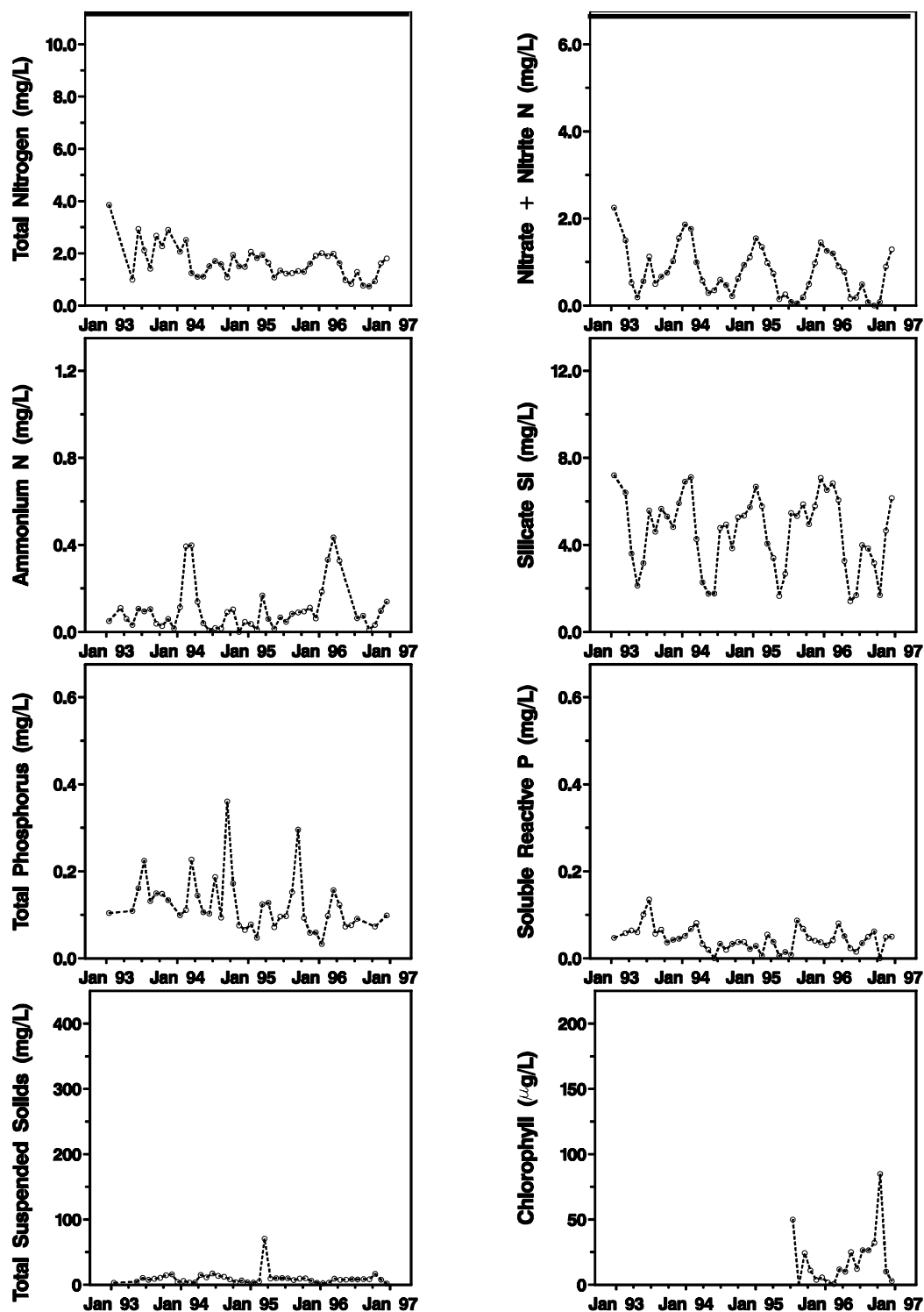


Figure E-2b. Monthly means of total nitrogen (mg/L), nitrate–nitrite nitrogen (mg/L), ammonium nitrogen (mg/L), silicate silicon (mg/L), total phosphorus (mg/L), soluble reactive phosphorus (mg/L), total suspended solids (mg/L), and chlorophyll a (μ g/L) in the Black River (sites B001.0N and BK01.0M) from 1993 through 1996.

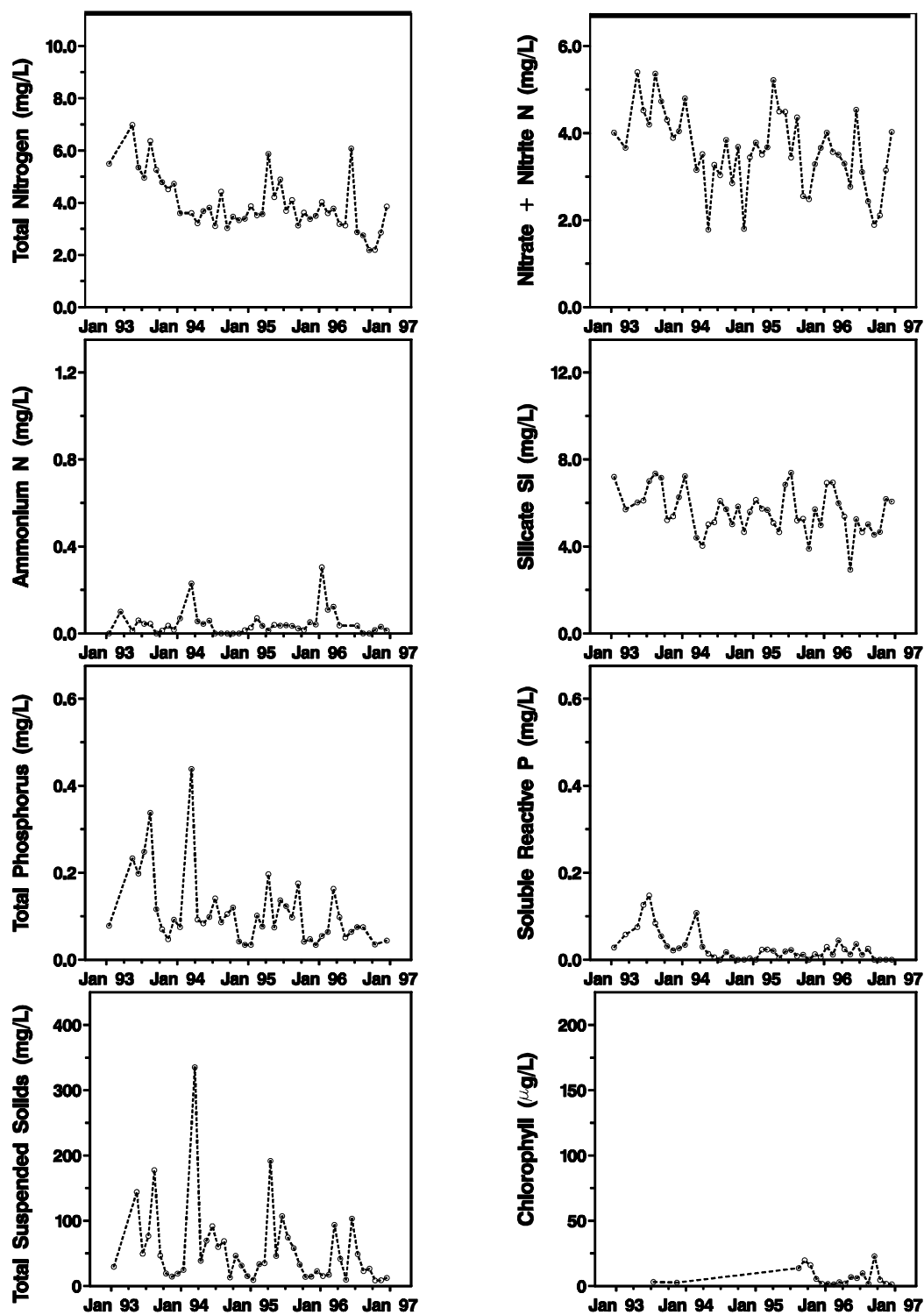


Figure E-2c. Monthly means of total nitrogen (mg/L), nitrate–nitrite nitrogen (mg/L), ammonium nitrogen (mg/L), silicate silicon (mg/L), total phosphorus (mg/L), soluble reactive phosphorus (mg/L), total suspended solids (mg/L), and chlorophyll a (μ g/L) in the Root River from 1993 through 1996.

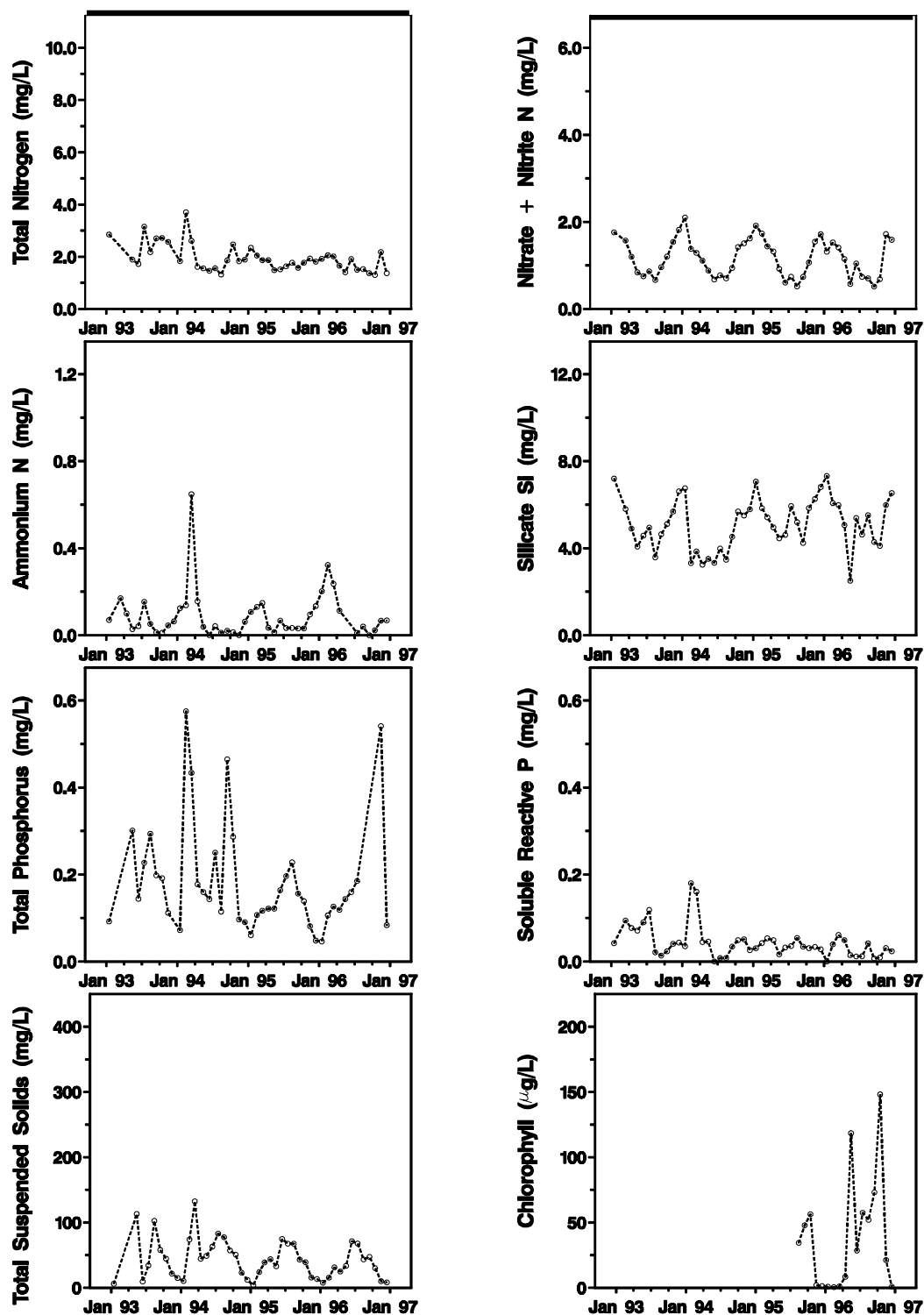


Figure E-2d. Monthly means of total nitrogen (mg/L), nitrate–nitrite nitrogen (mg/L), ammonium nitrogen (mg/L), silicate silicon (mg/L), total phosphorus (mg/L), soluble reactive phosphorus (mg/L), total suspended solids (mg/L), and chlorophyll a (µg/L) in the La Crosse River from 1993 through 1996.

Appendix F. Stratified Random Sampling Data: 1993–1996

In Appendix F, we summarize data from stratified random sampling (SRS) in both tabular and graphic forms. The tables contain summary statistics for each SRS episode and stratum divided into two parameter groups: (1) physical and biological measurements (Table F-1), and (2) chemical data (major plant nutrients; Table F-2). Within each parameter group, the data are divided by sampling depth into three groups (surface, middepth, and bottom). Chemical measurements are typically collected only at the surface and near the bottom. The majority of all measurement are in the near-surface category and most episodes do not have chemical data from other depths. Refer to Appendix A for maps and descriptions of the individual sampling strata and episodes.

The figures (F-1–F-13) are box-whisker diagrams that connect the medians for each sampling episode from spring 1993 through fall 1996. The 10th and 90th percentiles for each episode are indicated by the lower and upper limits of the box. Vertical lines extend above and below each box to the minimum and maximum observed value or to the limits of the plotting axis.

Data that have been flagged as questionable in the Long Term Resource Monitoring Program database because of recorder error, instrument malfunction, sample damage, contamination, improper handling, analytical error, or other difficulties are excluded from this summary. Values that are below detection are indicated by the detection limit preceded by a negative sign. Below-detection values are included in the determination of minima, maxima, and medians, but in the calculation of means and standard deviations, values below detection have been replaced by a value equal to half the detection limit. The Secchi transparency data in this report do not include observations where Secchi transparency exceeded the water column depth. High transparency conditions are thus underrepresented.

Table F-1. Summaries of physical–biological measurements during each stratified random sampling episode from 1993 through 1996. Data are grouped into three sampling-depth categories: near surface (less than or equal to 0.2 m below the surface), middepth, and near bottom (less than or equal to 0.2 m above the substrate).

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1993 Near-surface measurements: summer																			
1. Main channel	Mean	0.2	4.63	0.77	—	—	—	—	23.3	6.46	76	455	7.5	47	22	32.9	7.3	7.86	7.22
	Median	0.2	4.3	0.82	—	—	—	—	23.2	6.5	77	461	7.5	47	22	29.7	7.4	7.86	7.51
	Minimum	0.2	2.4	0.03	—	—	—	—	22.8	5.7	67	412	7.1	35	15	24.9	5.7	5.99	2.61
	Maximum	0.2	10.3	1.22	—	—	—	—	24	7.2	85	497	7.8	55	33	50.6	9.6	9.73	14.5
	Std. dev.	0	1.92	0.3	—	—	—	—	0.36	0.43	4.99	25	0.16	5.67	3.87	7.41	1.12	2.64	3.01
	N obs.	25	25	25	0	0	0	0	25	25	25	25	25	25	25	13	13	2	13
2. Side channel	Mean	0.2	2.49	0.52	—	—	—	—	23.3	6.56	77	456	7.6	46.4	21	31.1	6.7	11.2	8.12
	Median	0.2	2.35	0.5	—	—	—	—	23.2	6.5	78	455	7.6	49	20	26.6	6.1	11.2	8.09
	Minimum	0.2	0.5	0.02	—	—	—	—	22.7	5.4	63	407	7	21	10	11.6	4.6	11.2	2.55
	Maximum	0.2	5.2	1.2	—	—	—	—	24	7.5	88	505	7.8	60	53	86.6	14.3	11.2	11.8
	Std. dev.	0	1.13	0.29	—	—	—	—	0.36	0.42	5.16	29.6	0.16	9.09	8.26	17.4	2.22	—	2.95
	N obs.	30	30	30	0	0	0	0	30	29	29	30	30	30	30	16	16	1	16
3. Backwater	Mean	0.2	1.6	0.17	—	—	—	—	23.2	6.39	75	454	7.5	56.7	15	18.8	5.9	11.8	9.04
	Median	0.2	1.4	0.07	—	—	—	—	23.2	6.5	76	452	7.5	50	16	20	5.9	13.5	9.16
	Minimum	0.2	0.4	0	—	—	—	—	21.2	4	46	395	6.7	33	1	4.5	2.8	4.49	1
	Maximum	0.2	4.6	0.95	—	—	—	—	25.1	8.4	99	531	8	168	28	40.9	8.4	15.7	16.6
	Std. dev.	0	0.82	0.23	—	—	—	—	0.79	0.75	9.27	35.5	0.28	23.8	5.44	8.65	1.37	5.02	3.57
	N obs.	59	59	58	0	0	0	0	59	57	57	59	59	59	59	31	31	4	31
5. Impounded	Mean	0.2	1.66	0.32	—	—	—	—	23.6	6.73	80	458	7.6	45.4	22	30.9	6.9	—	6.9
	Median	0.2	1.4	0.31	—	—	—	—	23.7	6.7	79	464	7.6	47	17	24.6	6.5	—	7.16
	Minimum	0.2	1.1	0.03	—	—	—	—	22.9	6.3	74	297	7.1	26	13	16.2	5	—	1.56
	Maximum	0.2	3	0.52	—	—	—	—	25	7.2	86	494	7.8	57	52	84.5	13.1	—	12.7
	Std. dev.	0	0.53	0.12	—	—	—	—	0.47	0.25	3.21	38	0.18	9.14	10.5	18	2.04	—	3.91
	N obs.	25	25	25	0	0	0	0	25	23	23	25	25	25	25	13	13	0	13
6. Isolated	Mean	0.2	0.91	0	—	—	—	—	23.2	3.51	42	483	7.1	57.6	9	11.3	10.1	—	69.2
	Median	0.2	0.9	0	—	—	—	—	22.7	1.4	17	485	7.1	47	8	8.7	9.5	—	52.5
	Minimum	0.2	0.5	0	—	—	—	—	22	0.2	2	398	6.6	43	3	3.7	4	—	8.36
	Maximum	0.2	1.4	0	—	—	—	—	24.9	11.6	141	531	7.7	85	18	24.2	17.4	—	164
	Std. dev.	0	0.34	0	—	—	—	—	1.34	4.28	52.1	42.2	0.42	19	5.85	8.9	5.53	—	66.5
	N obs.	8	8	8	0	0	0	0	8	8	8	8	8	5	8	4	4	0	4

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1993 Middepth measurements: summer																			
3. Backwater	Mean	1.2	2.35	—	—	—	—	—	23.6	3	36	475	7.5	—	2	—	—	—	—
	Median	1.2	2.35	—	—	—	—	—	23.6	3	36	475	7.5	—	2	—	—	—	—
	Minimum	1.1	2.2	—	—	—	—	—	23.1	3	35	473	7.4	—	2	—	—	—	—
	Maximum	1.3	2.5	—	—	—	—	—	24	3	36	477	7.5	—	2	—	—	—	—
	Std. dev.	0.14	0.21	—	—	—	—	—	0.64	0	0.45	2.83	0.07	—	0	—	—	—	—
	N obs.	2	2	0	—	—	—	—	2	2	2	2	2	—	2	0	0	0	0
1993 Near-bottom measurements: summer																			
1. Main channel	Mean	2.2	2.4	—	—	—	—	—	23.8	5.8	69	—	—	—	—	—	—	—	—
	Median	2.2	2.4	—	—	—	—	—	23.8	5.8	69	—	—	—	—	—	—	—	—
	Minimum	2.2	2.4	—	—	—	—	—	23.8	5.8	69	—	—	—	—	—	—	—	—
	Maximum	2.2	2.4	—	—	—	—	—	23.8	5.8	69	—	—	—	—	—	—	—	—
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	0	0	—	0	0	0	0	0
2. Side channel	Mean	2	2.2	—	—	—	—	—	23.1	5.85	69	—	—	—	—	—	—	—	—
	Median	2	2.2	—	—	—	—	—	23.1	5.85	69	—	—	—	—	—	—	—	—
	Minimum	1.3	1.5	—	—	—	—	—	23	5.5	64	—	—	—	—	—	—	—	—
	Maximum	2.7	2.9	—	—	—	—	—	23.2	6.2	73	—	—	—	—	—	—	—	—
	Std. dev.	0.99	0.99	—	—	—	—	—	0.14	0.49	6.01	—	—	—	—	—	—	—	—
	N obs.	2	2	0	—	—	—	—	2	2	2	0	0	—	0	0	0	0	0
3. Backwater	Mean	1.69	1.89	0.02	—	—	—	—	22.7	5.46	64	480	7.2	—	5	—	—	—	—
	Median	1.6	1.8	0.02	—	—	—	—	22.9	5.8	68	481	7.3	—	6	—	—	—	—
	Minimum	0.5	0.7	0.01	—	—	—	—	21.1	0.4	5	462	7	—	2	—	—	—	—
	Maximum	4.4	4.6	0.03	—	—	—	—	23.9	7.3	84	497	7.4	—	6	—	—	—	—
	Std. dev.	0.81	0.81	0.01	—	—	—	—	0.69	1.58	18.5	14.9	0.17	—	1.89	—	—	—	—
	N obs.	31	31	4	—	—	—	—	31	30	30	4	4	—	4	0	0	0	0
5. Impounded	Mean	1.9	2.1	—	—	—	—	—	24	6.75	81	—	—	—	—	—	—	—	—
	Median	1.85	2.05	—	—	—	—	—	24.1	6.75	81	—	—	—	—	—	—	—	—
	Minimum	1.1	1.3	—	—	—	—	—	23.8	6.6	79	—	—	—	—	—	—	—	—
	Maximum	2.8	3	—	—	—	—	—	24.1	6.9	82	—	—	—	—	—	—	—	—
	Std. dev.	0.79	0.79	—	—	—	—	—	0.14	0.21	2.3	—	—	—	—	—	—	—	—
	N obs.	4	4	0	—	—	—	—	4	2	2	0	0	—	0	0	0	0	0

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1993 Near-bottom measurements: summer																			
6. Isolated	Mean	0.92	1.12	—	—	—	—	—	22.5	3.76	45	545	—	—	—	—	—	—	—
	Median	0.9	1.1	—	—	—	—	—	21.9	0.6	7	545	—	—	—	—	—	—	—
	Minimum	0.6	0.8	—	—	—	—	—	21.5	0.3	3	545	—	—	—	—	—	—	—
	Maximum	1.2	1.4	—	—	—	—	—	24	9.5	112	545	—	—	—	—	—	—	—
	Std. dev.	0.24	0.24	—	—	—	—	—	1.13	4.55	54.1	—	—	—	—	—	—	—	—
	N obs.	5	5	0	—	—	—	—	5	5	5	1	0	—	0	0	0	0	0
1993 Near-surface measurements: fall																			
1. Main channel	Mean	0.2	4.05	0.57	—	—	—	—	15.6	8.85	89	463	7.8	53.2	15	18.4	7	14.2	9.1
	Median	0.2	4.2	0.62	—	—	—	—	15.6	8.9	90	480	7.9	53	16	19.9	7	14.2	9.55
	Minimum	0.2	1.2	0	—	—	—	—	15	7.8	77	289	7	43	9	8.6	4	14.2	6.93
	Maximum	0.2	7.7	0.93	—	—	—	—	16	9.3	93	528	8.2	65	20	21.7	9.1	14.2	10.4
	Std. dev.	0	1.83	0.21	—	—	—	—	0.32	0.34	3.69	56	0.26	5.44	2.45	3.66	1.39	—	1.53
	N obs.	25	25	20	0	0	0	0	25	25	25	25	22	25	24	13	13	1	4
2. Side channel	Mean	0.2	2.12	0.25	—	—	—	—	15	9.16	91	441	7.5	56.4	14	17.1	6.7	12.7	10.4
	Median	0.2	1.5	0.23	—	—	—	—	15.2	9.1	90	460	7.6	55	14	16.6	6.5	12.7	10.8
	Minimum	0.2	0.3	0	—	—	—	—	13.1	7.8	77	108	6.9	45	6	8.2	5.4	12.7	1.95
	Maximum	0.2	6.4	0.69	—	—	—	—	16.3	10.8	105	531	8	75	23	31	8.1	12.7	18.3
	Std. dev.	0	1.57	0.17	—	—	—	—	0.73	0.7	6.45	83.1	0.29	8.26	3.68	5.43	0.84	—	4.4
	N obs.	30	30	30	0	0	0	0	30	29	29	30	29	27	30	16	16	1	11
3. Backwater	Mean	0.2	0.99	0.09	—	—	—	—	15.2	8.56	85	434	7.5	46.5	17	22.5	8.2	27.7	15.8
	Median	0.2	0.7	0.02	—	—	—	—	15.3	9.15	91	442	7.6	49	15	18.3	6.9	25.8	12.5
	Minimum	0.2	0.1	0	—	—	—	—	12.9	1.3	13	161	6.6	21	3	7.2	4.4	2.25	0
	Maximum	0.2	5.8	0.58	—	—	—	—	16.8	12.4	124	565	8.3	65	36	75.2	21.3	57.1	68.8
	Std. dev.	0	0.85	0.13	—	—	—	—	0.92	2.41	24.1	75.8	0.43	11.3	6.79	15.8	3.82	24	14.5
	N obs.	60	60	60	0	0	0	0	60	60	60	60	58	42	60	32	32	4	19
5. Impounded	Mean	0.2	1.21	0.16	—	—	—	—	15.4	9.16	92	453	7.6	53.8	15	18.6	6.4	11.2	14.7
	Median	0.2	1.1	0.15	—	—	—	—	15.3	8.8	88	460	7.6	53	15	18.8	6.6	11.2	13.6
	Minimum	0.2	0.5	0	—	—	—	—	14.2	8.5	85	385	7.1	43	12	7.3	4.6	11.2	10.9
	Maximum	0.2	2.5	0.48	—	—	—	—	16.2	10.8	110	504	8	62	24	28	8.8	11.2	26.5
	Std. dev.	0	0.46	0.1	—	—	—	—	0.43	0.7	7.56	31.3	0.29	5.25	2.52	6.2	1.25	—	4.4
	N obs.	23	23	18	0	0	0	0	23	23	23	23	23	23	23	12	12	1	10

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1993 Near-surface measurements: fall																			
6. Isolated	Mean	0.2	1.06	0.01	—	—	—	—	11.2	2.89	27	649	7	76.2	12	13.8	10.4	—	—
	Median	0.2	0.65	0	—	—	—	—	11.3	2.1	19	582	7	51	10	12.4	8.7	—	—
	Minimum	0.2	0.2	0	—	—	—	—	8.8	0.3	3	493	6.5	30	4	3.9	5.4	—	—
	Maximum	0.2	4.5	0.03	—	—	—	—	13	9.4	89	1128	7.8	150	25	25	17.1	—	—
	Std. dev.	0	1.25	0.01	—	—	—	—	1.62	3.22	30.6	199	0.42	50.4	6.44	10.6	6	—	—
	N obs.	10	10	10	0	0	0	0	10	10	10	10	10	6	10	3	3	0	0
1993 Near-bottom measurements: fall																			
3. Backwater	Mean	1.18	1.38	0.01	—	—	—	—	14.2	7.57	74	511	7.8	—	27	—	—	—	—
	Median	1.05	1.25	0.01	—	—	—	—	14.2	7.7	74	511	7.8	—	27	—	—	—	—
	Minimum	0.4	0.6	0.01	—	—	—	—	11.2	4.3	41	511	7.8	—	27	—	—	—	—
	Maximum	2.6	2.8	0.01	—	—	—	—	16.2	11.6	115	511	7.8	—	27	—	—	—	—
	Std. dev.	0.74	0.74	—	—	—	—	—	1.93	2.59	25.3	—	—	—	—	—	—	—	—
	N obs.	6	6	1	—	—	—	—	6	6	6	1	1	—	1	0	0	0	0
6. Isolated	Mean	2.03	2.23	—	—	—	—	—	12.7	5.15	48	—	—	—	—	—	—	—	—
	Median	1.2	1.4	—	—	—	—	—	12.7	5.15	48	—	—	—	—	—	—	—	—
	Minimum	0.6	0.8	—	—	—	—	—	12.5	2.7	25	—	—	—	—	—	—	—	—
	Maximum	4.3	4.5	—	—	—	—	—	12.9	7.6	71	—	—	—	—	—	—	—	—
	Std. dev.	1.99	1.99	—	—	—	—	—	0.2	3.46	32.4	—	—	—	—	—	—	—	—
	N obs.	3	3	0	—	—	—	—	3	2	2	0	0	—	0	0	0	0	0
1994 Near-surface measurements: winter																			
1. Main channel	Mean	0.2	4.77	0.23	99.2	31	83	5	-0.3	12.3	84	554	7.2	163	3	1.6	0.9	0.08	0
	Median	0.2	3.9	0.23	100	34	100	4	0	12.2	83	570	7.1	151	2	1.6	1	0.08	0
	Minimum	0.2	1.5	0.08	95	6	10	0	-0.2	12	82	482	7	120	2	-0.1	0.6	-1	0
	Maximum	0.2	9.1	0.37	100	40	100	14	0	12.8	87	591	7.8	214	4	4.2	1.3	1.17	0
	Std. dev.	0	2.69	0.1	1.95	9.31	31.7	4.3	0.06	0.31	2.1	36.4	0.27	32.4	0.79	0.97	0.21	1.53	0
	N obs.	12	10	12	12	12	12	12	12	9	9	12	12	10	12	12	12	2	12
2. Side channel	Mean	0.2	2.12	0.15	99.4	35	96	10	-0.1	12.4	85	579	7.2	138	3	2.7	1.1	-1	0
	Median	0.2	2	0.12	100	35	100	8	0	12.1	83	574	7.1	131	3	2.5	1	-1	0
	Minimum	0.2	0.42	0	90	12	5	0	-0.1	11	75	492	6.4	119	2	1.2	0.7	-1	0
	Maximum	0.2	6.7	0.36	100	55	100	25	0	17.4	119	679	7.8	190	5	6.4	2.2	-1	0
	Std. dev.	0	1.33	0.08	2.12	10.8	18.5	7	0.03	1.21	8.22	35.7	0.29	20	0.62	1.32	0.36	—	0
	N obs.	27	27	27	27	27	27	26	27	26	26	27	27	21	27	27	27	1	27

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1994 Near-surface measurements: spring																			
2. Side channel	Mean	0.2	2.67	0.56	—	—	—	—	11.9	10	93	342	7.6	57.4	15	24.6	6.1	32.7	24
	Median	0.2	2.3	0.6	—	—	—	—	12	9.8	90	320	7.5	58	16	24.9	6	23.7	22.1
	Minimum	0.2	0.7	0.02	—	—	—	—	10.4	9.3	86	154	7.1	44	8	10.2	4.6	17.6	10.8
	Maximum	0.2	6.4	1	—	—	—	—	15.2	12.7	127	453	8.4	70	25	44.5	8.6	73.4	60.7
	Std. dev.	0	1.55	0.28	—	—	—	—	0.98	0.67	8.16	66.5	0.35	6.73	3.7	6.9	0.94	23.1	9.55
	N obs.	29	29	13	0	0	0	0	29	29	29	29	29	29	29	29	29	5	29
3. Backwater	Mean	0.2	1.4	0.17	—	—	—	—	13	11.5	110	340	7.7	64.5	11	17.8	6.1	46	31.9
	Median	0.2	1.26	0.08	—	—	—	—	12.8	10.4	98	335	7.8	62.5	11	15.4	6	44.9	27.1
	Minimum	0.2	0.45	0	—	—	—	—	10.8	9.2	83	105	6.7	39	4	5.2	3.1	30.7	0
	Maximum	0.2	2.8	0.6	—	—	—	—	16.7	17.5	170	456	8.9	98	21	45.7	13.2	62.4	77.8
	Std. dev.	0	0.63	0.19	—	—	—	—	1.33	2.25	23.4	69.8	0.52	12.6	3.93	8.63	1.89	15.9	16.1
	N obs.	60	60	19	0	0	0	0	60	60	60	60	60	56	60	60	60	3	60
5. Impounded	Mean	0.2	1.81	0.43	—	—	—	—	11.7	10.1	93	361	7.7	52.1	18	28.9	6.9	20.6	24.5
	Median	0.2	1.4	0.43	—	—	—	—	11.8	10	92	371	7.8	50.5	17	27.5	6.6	20.6	22.8
	Minimum	0.2	0.8	0.16	—	—	—	—	10.4	9.3	86	276	7	46	13	12.9	5.4	20.6	14.5
	Maximum	0.2	6.5	0.6	—	—	—	—	13.8	11.8	114	430	8.3	60	29	44.3	9.9	20.6	55.8
	Std. dev.	0	1.24	0.15	—	—	—	—	0.64	0.49	5.24	48.7	0.29	4.55	3.86	7.49	1.14	—	8.03
	N obs.	26	26	17	0	0	0	0	26	26	26	26	26	26	26	25	25	1	25
6. Isolated	Mean	0.2	1.03	0	—	—	—	—	15.4	13.8	138	405	8.4	75.5	6	10.4	7.8	46.5	38.7
	Median	0.2	1.06	0	—	—	—	—	15.1	14.1	140	401	8.5	77.5	6	10.5	8.3	46.5	43.1
	Minimum	0.2	0.73	0	—	—	—	—	15	11.6	118	388	7.9	60	4	2.8	1.9	46.5	3.17
	Maximum	0.2	1.3	0	—	—	—	—	17	15.2	157	454	8.7	98	8	15.3	10.9	46.5	53.8
	Std. dev.	0	0.18	0	—	—	—	—	0.63	1.27	13	18.9	0.27	12.9	1.32	3.65	2.41	—	15.4
	N obs.	10	10	8	0	0	0	0	10	10	10	10	10	8	10	10	10	1	10
1994 Middepth measurements: spring																			
3. Backwater	Mean	0.97	1.92	—	—	—	—	—	13.2	16.1	153	—	—	—	—	—	—	—	—
	Median	0.9	1.76	—	—	—	—	—	13.2	15.7	150	—	—	—	—	—	—	—	—
	Minimum	0.6	1.2	—	—	—	—	—	13	15.4	147	—	—	—	—	—	—	—	—
	Maximum	1.4	2.8	—	—	—	—	—	13.3	17.2	163	—	—	—	—	—	—	—	—
	Std. dev.	0.4	0.81	—	—	—	—	—	0.15	0.96	8.71	—	—	—	—	—	—	—	—
	N obs.	3	3	0	—	—	—	—	3	3	3	0	0	—	0	0	0	0	0

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1994 Near-bottom measurements: spring																			
3. Backwater	Mean	1.42	1.63	—	—	—	—	—	11.8	12.3	113	271	8.1	—	12	17	7.7	—	45.1
	Median	1.3	1.53	—	—	—	—	—	11.9	11.7	108	269	8.1	—	12	17	7.7	—	45.1
	Minimum	0.7	0.88	—	—	—	—	—	10.7	9	84	125	8.1	—	12	17	7.7	—	45.1
	Maximum	2.6	2.8	—	—	—	—	—	13.3	16.4	150	413	8.1	—	12	17	7.7	—	45.1
	Std. dev.	0.65	0.64	—	—	—	—	—	0.76	2.4	21.7	128	—	—	—	—	—	—	—
	N obs.	13	13	0	—	—	—	—	13	13	13	5	1	—	1	1	1	0	1
6. Isolated	Mean	0.91	1.12	—	—	—	—	—	15	13.7	136	—	—	—	—	—	—	—	—
	Median	0.9	1.1	—	—	—	—	—	15.1	13.8	137	—	—	—	—	—	—	—	—
	Minimum	0.8	1	—	—	—	—	—	13.8	12.4	123	—	—	—	—	—	—	—	—
	Maximum	1.1	1.3	—	—	—	—	—	15.4	14.6	145	—	—	—	—	—	—	—	—
	Std. dev.	0.11	0.11	—	—	—	—	—	0.53	0.83	8.22	—	—	—	—	—	—	—	—
	N obs.	7	7	0	—	—	—	—	7	7	7	0	0	—	0	0	0	0	0
1994 Near-surface measurements: summer																			
1. Main channel	Mean	0.2	4.37	0.49	—	—	—	—	24	9.48	113	420	8.2	54.3	18	25.6	9.5	44.5	56.6
	Median	0.2	4.01	0.5	—	—	—	—	23.8	9.45	112	422	8.2	55	18	26	9.3	44.5	54.8
	Minimum	0.2	1.1	0.08	—	—	—	—	22.8	8.4	98	372	7.5	41	12	19.6	7.8	42.7	34.3
	Maximum	0.2	9.5	0.88	—	—	—	—	26.1	11.8	147	464	9.1	68	23	32	14.1	46.4	104
	Std. dev.	0	2.07	0.21	—	—	—	—	0.78	0.66	9.09	20.2	0.29	6.61	2.68	3.36	1.36	1.78	13.6
	N obs.	26	26	24	0	0	0	0	26	26	26	26	26	26	26	26	26	4	26
2. Side channel	Mean	0.2	2.89	0.27	—	—	—	—	24.4	9.6	116	406	8.3	50.6	18	25.8	9.7	52.9	56.3
	Median	0.2	2.5	0.27	—	—	—	—	24.2	9.6	115	408	8.3	52	17	24.1	9.4	41.2	54.8
	Minimum	0.2	0.4	0	—	—	—	—	22.7	8.1	96	373	7.8	27	12	12.6	7.5	37.4	34.7
	Maximum	0.2	7.55	0.65	—	—	—	—	25.9	11.8	145	426	8.7	64	29	55.5	13.8	80.1	117
	Std. dev.	0	1.8	0.19	—	—	—	—	0.72	0.93	12.4	13.2	0.19	9.77	4.29	9.02	1.42	23.6	15.3
	N obs.	29	29	28	0	0	0	0	28	29	28	29	29	28	29	29	29	3	29
3. Backwater	Mean	0.2	0.96	0.05	—	—	—	—	24.8	10.3	126	406	8.2	44.4	22	34.3	12.2	49	59.3
	Median	0.2	0.66	0.01	—	—	—	—	24.9	10.4	125	408	8.3	43	19	26.9	11.7	55.4	54.3
	Minimum	0.1	0.14	0	—	—	—	—	20	2.3	27	336	6.9	22	2	2.9	2.6	14.2	2.38
	Maximum	0.2	6.5	0.41	—	—	—	—	29.9	16.8	205	470	8.9	95	59	155	34.4	67.4	198
	Std. dev.	0.01	1	0.08	—	—	—	—	1.82	2.75	36.1	26	0.44	13.2	10.8	27.8	4.98	21.6	30.1
	N obs.	60	60	57	0	0	0	0	60	60	60	60	60	50	60	57	57	5	58

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1994 Near-surface measurements: summer																			
5. Impounded	Mean	0.2	1.04	0.12	—	—	—	—	25.1	10.5	128	402	8.4	41.5	23	33.9	10.5	53.1	73.6
	Median	0.2	1	0.11	—	—	—	—	25.2	10.6	129	401	8.4	42	20	28.2	10.6	53.1	75.7
	Minimum	0.2	0.3	0.01	—	—	—	—	23.2	8.3	100	392	8	24	14	18.2	7.8	48.7	50.2
	Maximum	0.2	2	0.29	—	—	—	—	27	13.2	168	419	8.9	57	41	82.7	14.3	57.6	108
	Std. dev.	0	0.43	0.07	—	—	—	—	0.9	1.4	18.9	8.57	0.23	8.79	7.35	15	1.73	6.35	14.1
	N obs.	25	25	24	0	0	0	0	25	25	25	25	25	25	25	25	25	2	25
6. Isolated	Mean	0.2	1.27	0	—	—	—	—	22.6	1.91	23	603	7.6	47.1	8	21.4	14.5	25.5	29
	Median	0.2	0.55	0	—	—	—	—	22.3	0.75	8	545	7.4	35	7	24.8	16.2	25.5	21.8
	Minimum	0.2	0.38	0	—	—	—	—	20.3	0.2	2	412	6.6	20	3	1.9	4.6	25.5	7.7
	Maximum	0.2	7.7	0.04	—	—	—	—	25	7.8	95	1068	10.1	160	17	39.4	22.8	25.5	60.5
	Std. dev.	0	2.26	0.01	—	—	—	—	1.76	2.61	31.8	230	1.14	40.8	5.46	14.9	6.83	—	20.6
	N obs.	10	10	10	0	0	0	0	10	10	10	10	10	10	10	10	10	1	10
1994 Middepth measurements: summer																			
3. Backwater	Mean	1.63	3.34	—	—	—	—	—	22.9	7.47	89	429	8	—	15	16.9	13.8	—	312
	Median	1.4	2.81	—	—	—	—	—	23.4	7.85	93	434	8.2	—	16	16.9	13.8	—	312
	Minimum	0.7	1.4	—	—	—	—	—	19.4	0.3	3	399	7	—	9	6.2	3.3	—	312
	Maximum	3.2	6.5	—	—	—	—	—	24.4	12.8	152	450	8.4	—	18	27.6	24.2	—	312
	Std. dev.	0.9	1.84	—	—	—	—	—	1.84	4.03	47.9	24.1	0.65	—	4.04	15.1	14.8	—	—
	N obs.	6	6	0	—	—	—	—	6	6	6	4	4	—	4	2	2	0	1
1994 Near-bottom measurements: summer																			
3. Backwater	Mean	2.79	2.98	—	—	—	—	—	20.7	5.2	61	454	7.6	—	26	26.8	12.2	—	61.8
	Median	2.5	2.68	—	—	—	—	—	22.8	6.1	72	421	7.6	—	11	28.7	14.5	—	52.9
	Minimum	0.7	0.85	—	—	—	—	—	11	0.2	2	418	6.8	—	4	14.2	6.1	—	39.1
	Maximum	6.3	6.5	—	—	—	—	—	24	9.6	112	539	8.7	—	77	37.4	15.9	—	93.6
	Std. dev.	1.92	1.93	—	—	—	—	—	4.8	3.71	43.6	52.8	0.81	—	34.4	11.7	5.3	—	28.3
	N obs.	7	7	0	—	—	—	—	7	7	7	5	5	—	4	3	3	0	3
6. Isolated	Mean	2.2	2.41	—	—	—	—	—	18.7	0.98	12	—	—	—	—	—	—	—	—
	Median	0.5	0.7	—	—	—	—	—	20.6	0.25	3	—	—	—	—	—	—	—	—
	Minimum	0.3	0.54	—	—	—	—	—	9.2	0.2	2	—	—	—	—	—	—	—	—
	Maximum	7.5	7.7	—	—	—	—	—	24.6	3.2	39	—	—	—	—	—	—	—	—
	Std. dev.	3.54	3.53	—	—	—	—	—	6.64	1.48	18.2	—	—	—	—	—	—	—	—
	N obs.	4	4	0	—	—	—	—	4	4	4	0	0	—	0	0	0	0	0

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1994 Near-surface measurements: fall																			
1. Main channel	Mean	0.2	4.08	0.41	—	—	—	—	13.2	9.48	90	400	8.1	51.4	17	20.1	5.1	12.5	12.3
	Median	0.2	3.66	0.42	—	—	—	—	13.2	9.5	90	409	8.1	50	18	20.6	5	11.2	12
	Minimum	0.2	0.95	0.11	—	—	—	—	12.3	9.1	87	349	7.9	42	12	13.1	3.7	9.73	7.96
	Maximum	0.2	7.98	0.72	—	—	—	—	14.2	9.9	96	434	8.3	70	21	25.9	7.1	19.5	17.5
	Std. dev.	0	1.79	0.18	—	—	—	—	0.52	0.24	2.37	21.1	0.14	6.67	2.39	3.03	0.86	3.39	2.45
	N obs.	26	26	26	0	0	0	0	26	26	26	26	26	26	26	26	26	7	26
2. Side channel	Mean	0.2	2.3	0.3	—	—	—	—	13.4	9.55	91	387	8.1	51.9	17	20.4	5.6	12	11.4
	Median	0.2	1.91	0.31	—	—	—	—	13.4	9.6	90	389	8.1	51	16	18	5.5	12	11.1
	Minimum	0.2	0.35	0	—	—	—	—	11.7	8.9	82	325	7.8	37	11	10.2	1.8	10.5	2.52
	Maximum	0.2	5.6	0.65	—	—	—	—	15.1	10.4	103	417	8.3	65	27	42.8	14.1	13.5	17.8
	Std. dev.	0	1.43	0.17	—	—	—	—	0.58	0.33	3.86	18.6	0.14	7.38	3.55	7.21	2.08	2.11	2.83
	N obs.	31	31	31	0	0	0	0	31	31	31	31	31	30	31	30	30	2	29
3. Backwater	Mean	0.2	0.93	0.08	—	—	—	—	13.9	9.67	94	381	8.1	50.8	17	20.9	6.5	17.3	21.8
	Median	0.2	0.71	0	—	—	—	—	13.8	9.65	93	386	8.1	50	16	19.2	5.5	12.7	12.7
	Minimum	0.2	0.26	0	—	—	—	—	10.7	6.7	66	245	7.5	27	8	0.5	2.5	11.2	4.25
	Maximum	0.2	7.01	0.42	—	—	—	—	16.4	13.3	134	493	8.7	85	31	55.8	13.5	27.7	99.4
	Std. dev.	0	0.96	0.12	—	—	—	—	1.1	1.17	11.9	43.5	0.26	11.5	4.63	9.54	2.39	7.37	20.2
	N obs.	58	58	58	0	0	0	0	58	58	58	58	58	42	58	57	57	5	57
5. Impounded	Mean	0.2	1.18	0.17	—	—	—	—	13.2	9.71	93	386	8.2	45.8	18	21.9	5.6	—	11.1
	Median	0.2	0.93	0.13	—	—	—	—	13.1	9.7	92	389	8.2	48	17	22.1	5.7	—	11.2
	Minimum	0.2	0.45	0.06	—	—	—	—	12.1	9.2	88	360	7.9	32	14	1.7	0.4	—	8.01
	Maximum	0.2	3.8	0.43	—	—	—	—	15.1	10.3	101	404	8.3	55	24	33.6	8	—	16
	Std. dev.	0	0.71	0.08	—	—	—	—	0.72	0.31	3.9	13.7	0.13	5.98	3.1	6.77	1.76	—	1.92
	N obs.	25	25	25	0	0	0	0	25	25	25	25	25	25	25	25	25	0	25
6. Isolated	Mean	0.2	0.68	0	—	—	—	—	17	5.34	55	703	7.5	54.6	13	26.9	13.7	55.4	61.2
	Median	0.2	0.61	0	—	—	—	—	17.4	5.2	54	588	7.5	44	14	23.2	11.8	55.4	43.5
	Minimum	0.2	0.36	0	—	—	—	—	14.5	3.3	35	537	7.2	30	5	7.1	3.6	55.4	11.2
	Maximum	0.2	1.15	0	—	—	—	—	18.2	8.2	80	989	8.3	80	23	63.4	28.3	55.4	185
	Std. dev.	0	0.24	0	—	—	—	—	1.09	1.33	12.5	194	0.3	23.3	7.5	21.2	9.04	—	58.7
	N obs.	10	10	10	0	0	0	0	10	10	10	10	10	5	10	10	10	1	10

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1994 Middepth measurements: fall																			
3. Backwater	Mean	2.72	4.86	—	—	—	—	—	13.7	8.53	83	386	7.9	—	14	—	—	—	—
	Median	2.55	4.93	—	—	—	—	—	13.6	7.8	75	386	7.8	—	12	—	—	—	—
	Minimum	1	2.42	—	—	—	—	—	13.1	7.1	68	329	7.4	—	12	—	—	—	—
	Maximum	5.1	7.01	—	—	—	—	—	14.9	12.2	121	443	8.6	—	17	—	—	—	—
	Std. dev.	1.68	2.37	—	—	—	—	—	0.73	1.99	20.8	61	0.49	—	2.89	—	—	—	—
	N obs.	6	6	0	—	—	—	—	6	6	6	6	6	—	3	0	0	0	0
1994 Near-bottom measurements: fall																			
3. Backwater	Mean	2.26	2.56	—	—	—	—	—	14.5	8.36	82	398	8.2	—	18	—	—	—	—
	Median	2	2.24	—	—	—	—	—	15	9	90	395	8.3	—	18	—	—	—	—
	Minimum	0.8	0.96	—	—	—	—	—	13.1	6.6	63	331	7.5	—	14	—	—	—	—
	Maximum	6.2	7.01	—	—	—	—	—	15.4	9.7	96	442	8.7	—	23	—	—	—	—
	Std. dev.	1.88	2.09	—	—	—	—	—	0.89	1.13	12.5	39.5	0.38	—	4.69	—	—	—	—
	N obs.	7	7	0	—	—	—	—	7	7	7	7	7	—	4	0	0	0	0
6. Isolated	Mean	0.65	0.88	—	—	—	—	—	14.8	6.65	65	572	7.9	—	6	—	—	—	—
	Median	0.65	0.88	—	—	—	—	—	14.8	6.65	65	572	7.9	—	6	—	—	—	—
	Minimum	0.5	0.75	—	—	—	—	—	14.2	5.3	53	547	7.5	—	6	—	—	—	—
	Maximum	0.8	1	—	—	—	—	—	15.3	8	78	597	8.3	—	6	—	—	—	—
	Std. dev.	0.21	0.18	—	—	—	—	—	0.78	1.91	17.7	35.4	0.57	—	—	—	—	—	—
	N obs.	2	2	0	—	—	—	—	2	2	2	2	2	—	1	0	0	0	0
1994 Other measurements: fall																			
3. Backwater	Mean	1.5	7.01	—	—	—	—	—	13.1	7.3	69	380	7.5	—	—	—	—	—	—
	Median	1.5	7.01	—	—	—	—	—	13.1	7.3	69	380	7.5	—	—	—	—	—	—
	Minimum	1.5	7.01	—	—	—	—	—	13.1	7.3	69	380	7.5	—	—	—	—	—	—
	Maximum	1.5	7.01	—	—	—	—	—	13.1	7.3	69	380	7.5	—	—	—	—	—	—
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	1	1	—	0	0	0	0	0

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1995 Near-surface measurements: winter																			
1. Main channel	Mean	0.2	4.24	0.23	95.2	21	70	1	-0.1	15.1	103	468	8.4	124	3	4.1	2.7	—	28.9
	Median	0.2	4.21	0.21	100	20	80	1	0	15.1	103	466	8.4	127	3	4	2.8	—	29.4
	Minimum	0.2	0.82	0.06	60	6	5	0	-0.1	14	96	443	8.3	87	2	3.1	1.9	—	20
	Maximum	0.2	7.7	0.54	100	38	100	3	0.1	16.7	114	491	8.5	150	6	5.5	3.7	—	41.7
	Std. dev.	0	1.93	0.12	9.94	8.17	29.7	.95	0.08	0.65	4.45	13.7	0.06	15.8	1.09	0.57	0.39	—	4.92
	N obs.	24	24	23	22	22	22	21	24	24	24	24	24	24	23	24	24	24	0
2. Side channel	Mean	0.19	1.96	0.13	97.8	21	77	2	0.13	15	103	464	8.5	119	6	13.7	3.2	42.3	29.2
	Median	0.2	1.75	0.11	100	20	97	2	0.1	15.1	104	447	8.5	120	4	4	2.5	40.8	29.3
	Minimum	0	0.32	0	50	7	0	0	-0.1	12	83	436	8.4	51	2	3.2	2.1	37.4	21.4
	Maximum	0.2	5.04	0.27	100	39	100	4	0.6	16.2	111	576	8.6	159	59	262	16.6	48.7	41.8
	Std. dev.	0.05	1.3	0.07	10.2	10.2	31.7	1.1	0.14	0.87	5.86	33.5	0.07	22	10.7	49.5	2.71	5.76	4.3
	N obs.	27	27	25	24	24	24	24	27	27	27	27	27	27	19	27	27	27	3
3. Backwater	Mean	0.18	0.84	0.05	99.7	32	90	2	0.24	16.1	111	475	8.5	87.1	5	7.5	3.5	33.9	34.8
	Median	0.2	0.68	0.01	100	35	100	2	0.1	15.5	106	450	8.5	92.5	5	4.5	2.7	36.9	28.7
	Minimum	0	0.33	0	90	15	40	0	-0.1	11	77	397	7.6	48	2	3.1	0.3	15.4	19.5
	Maximum	0.2	4.22	0.26	100	49	100	6	0.8	22.2	155	762	8.8	121	13	25.5	17.2	46.4	158
	Std. dev.	0.05	0.68	0.07	1.74	8.72	19.5	1.3	0.24	2.44	17.1	69.9	0.25	29	2.5	5.98	3.11	13.5	24.5
	N obs.	33	33	29	33	33	33	32	33	33	33	33	33	33	8	31	32	32	4
5. Impounded	Mean	0.2	1.46	0.09	100	31	85	1	0.04	16.1	110	459	8.5	118	3	3.8	2.4	36	29.9
	Median	0.2	1.39	0.08	100	30	90	1	0	16	109	457	8.5	115	3	4	2.7	37.4	29.5
	Minimum	0.2	0.44	0.03	100	24	50	0	-0.1	14.8	101	432	8.4	96	1	2	-0.1	31.1	21.5
	Maximum	0.2	3.07	0.19	100	43	100	3	0.2	17.8	122	499	8.6	143	4	4.6	3.8	39.6	36.8
	Std. dev.	0	0.63	0.04	0	4.55	14.1	.87	0.09	0.87	6.18	17.6	0.09	14.9	0.76	0.66	1.04	4.44	3.92
	N obs.	24	24	22	24	24	24	24	24	24	24	24	24	24	15	24	24	24	3
6. Isolated	Mean	0.15	2.22	0	100	34	81	1	1.28	9.98	70	1303	7.7	54	14	12.7	9.1	63.2	88.3
	Median	0.15	0.69	0	100	35	98	1	0.95	9.35	66	1122	7.7	54	13	13.1	7.4	63.2	39.8
	Minimum	0.1	0.5	0	100	30	30	1	0.5	1.2	9	895	6.7	43	7	5.4	2.5	63.2	27.7
	Maximum	0.2	7	0	100	37	100	1	2.7	20	140	2071	8.7	65	22	19.1	19.2	63.2	246
	Std. dev.	0.06	3.19	0	0	2.94	34.2	0	0.97	9.77	68.5	525	0.9	15.6	6.35	5.61	7.13	—	105
	N obs.	4	4	3	4	4	4	4	4	4	4	4	4	4	2	4	4	4	1

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1995 Middepth measurements: winter																			
6. Isolated	Mean	1.95	3.94	—	—	—	—	—	2.2	11.4	81	1199	7.8	—	—	—	—	—	—
	Median	1.95	3.94	—	—	—	—	—	2.2	11.4	81	1199	7.8	—	—	—	—	—	—
	Minimum	0.4	0.87	—	—	—	—	—	1.2	2.8	21	1188	6.9	—	—	—	—	—	—
	Maximum	3.5	7	—	—	—	—	—	3.2	20	141	1210	8.6	—	—	—	—	—	—
	Std. dev.	2.19	4.33	—	—	—	—	—	1.41	12.2	85.2	15.6	1.2	—	—	—	—	—	—
	N obs.	2	2	0	—	—	—	—	2	2	2	2	2	—	0	0	0	0	0
1995 Near-bottom measurements: winter																			
6. Isolated	Mean	6.8	7	—	—	—	—	—	3.2	2.8	21	1365	6.8	—	74	19.5	6.6	—	8.39
	Median	6.8	7	—	—	—	—	—	3.2	2.8	21	1365	6.8	—	74	19.5	6.6	—	8.39
	Minimum	6.8	7	—	—	—	—	—	3.2	2.8	21	1365	6.8	—	74	19.5	6.6	—	8.39
	Maximum	6.8	7	—	—	—	—	—	3.2	2.8	21	1365	6.8	—	74	19.5	6.6	—	8.39
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	1	1	—	1	1	1	0	1
1995 Near-surface measurements: spring																			
1. Main channel	Mean	0.2	4.38	0.75	—	—	—	—	12.4	12.6	118	506	8.8	60.4	15	26.9	8.6	63.6	59.3
	Median	0.2	3.9	0.79	—	—	—	—	12.4	12.1	115	502	8.8	60	15	26.3	8.8	57.1	49.2
	Minimum	0.2	1.31	0	—	—	—	—	11	10.5	97	428	8.7	46	11	17.7	6	56.9	31.9
	Maximum	0.2	9.6	1.12	—	—	—	—	13.7	17.1	164	553	9	69	21	41.3	12.4	76.7	91
	Std. dev.	0	2.35	0.26	—	—	—	—	0.66	2.06	19.1	35.9	0.13	5.41	2.25	4.56	1.61	11.4	19.3
	N obs.	25	25	25	0	0	0	0	25	25	25	25	25	25	25	25	25	3	25
2. Side channel	Mean	0.2	2.33	0.48	—	—	—	—	12.4	13.3	125	476	8.9	57.9	15	26.4	8.6	63.6	68.2
	Median	0.2	1.64	0.53	—	—	—	—	12.3	13.8	131	468	8.9	57	15	25.5	9	63.6	63.2
	Minimum	0.2	0.59	0.1	—	—	—	—	11.2	10.4	98	384	8.7	49	9	17.6	5.3	53.9	35.2
	Maximum	0.2	5.4	0.8	—	—	—	—	14.8	17.2	161	553	9.2	70	20	38.6	11.5	73.4	121
	Std. dev.	0	1.46	0.18	—	—	—	—	0.7	2.27	20.7	51.8	0.15	5.95	2.39	4.76	1.53	13.8	21.7
	N obs.	32	32	32	0	0	0	0	32	32	32	32	32	30	32	32	32	2	30
3. Backwater	Mean	0.2	1.01	0.11	—	—	—	—	13.4	14.7	141	445	8.9	59.4	14	23.9	9.2	57.1	77.3
	Median	0.2	0.96	0.02	—	—	—	—	13	14.8	140	441	9	60	14	22.6	9.4	50.5	79.7
	Minimum	0.2	0.24	0	—	—	—	—	11.7	6.5	65	282	8.1	40	8	13	5.2	30.8	35.8
	Maximum	0.2	2.67	0.6	—	—	—	—	19.9	25	275	542	9.4	86	25	52.5	13.6	126	128
	Std. dev.	0	0.48	0.18	—	—	—	—	1.53	3.92	40.2	56.1	0.3	9.67	3.74	7.88	1.92	30.3	23.2
	N obs.	58	58	58	0	0	0	0	58	58	58	58	58	45	58	58	58	8	58

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1995 Near-surface measurements: spring																			
5. Impounded	Mean	0.2	1.67	0.29	—	—	—	—	12.3	16	150	458	9	54.5	15	29.3	10.5	89.8	83.1
	Median	0.2	1.55	0.3	—	—	—	—	11.9	15.8	147	471	9	53	16	29.7	10.8	89.8	88.9
	Minimum	0.2	0.56	0.04	—	—	—	—	11.2	13.1	126	393	8.8	45	8	13	6.1	89.8	10.5
	Maximum	0.2	4	0.49	—	—	—	—	14.9	19.3	187	543	9.3	77	19	39.8	15.1	89.8	114
	Std. dev.	0	0.92	0.11	—	—	—	—	1.03	1.6	16.2	45.3	0.13	7.06	2.54	5.89	2.04	—	25.4
	N obs.	25	25	25	0	0	0	0	25	25	25	25	25	24	25	25	25	1	25
6. Isolated	Mean	0.2	1.28	0	—	—	—	—	13.9	10.1	100	582	8.1	155	9	14.9	8.9	74.5	39.6
	Median	0.2	0.59	0	—	—	—	—	13.4	6.35	61	583	7.7	155	8	11.9	6.6	74.5	20.1
	Minimum	0.2	0.5	0	—	—	—	—	12.3	4.5	44	521	7.4	155	4	5	3.3	38.7	6.23
	Maximum	0.2	7.15	0	—	—	—	—	18.8	25	269	638	9.9	155	17	30.7	19.6	110	132
	Std. dev.	0	2.07	0	—	—	—	—	2.03	8.04	86	30.5	0.88	—	4.29	9.23	5.83	50.7	47.2
	N obs.	10	10	9	0	0	0	0	10	10	10	10	10	1	10	10	10	2	10
1995 Middepth measurements: spring																			
6. Isolated	Mean	3.5	7.15	—	—	—	—	—	11.1	1.68	16	563	7.5	—	—	—	—	—	—
	Median	3.5	7.15	—	—	—	—	—	11.3	1.2	11	562	7.5	—	—	—	—	—	—
	Minimum	2	7.15	—	—	—	—	—	8	0.1	1	538	7.3	—	—	—	—	—	—
	Maximum	5	7.15	—	—	—	—	—	13.8	4.2	41	589	7.6	—	—	—	—	—	—
	Std. dev.	1.29	0	—	—	—	—	—	2.5	1.98	19.1	22.4	0.13	—	—	—	—	—	—
	N obs.	4	4	0	—	—	—	—	4	4	4	4	4	—	0	0	0	0	0
1995 Near-bottom measurements: spring																			
6. Isolated	Mean	6.5	7.15	—	—	—	—	—	5.6	0.1	1	905	7.2	—	—	—	—	—	—
	Median	6.5	7.15	—	—	—	—	—	5.6	0.1	1	905	7.2	—	—	—	—	—	—
	Minimum	6	7.15	—	—	—	—	—	4.8	0.1	1	663	7	—	—	—	—	—	—
	Maximum	7	7.15	—	—	—	—	—	6.4	0.1	1	1147	7.3	—	—	—	—	—	—
	Std. dev.	0.71	0	—	—	—	—	—	1.13	0	0.02	342	0.21	—	—	—	—	—	—
	N obs.	2	2	0	—	—	—	—	2	2	2	2	2	—	0	0	0	0	0

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1995 Other measurements: spring																			
6. Isolated	Mean	1	7.15	—	—	—	—	—	13.9	4.3	42	589	7.6	—	—	—	—	—	—
	Median	1	7.15	—	—	—	—	—	13.9	4.3	42	589	7.6	—	—	—	—	—	—
	Minimum	1	7.15	—	—	—	—	—	13.9	4.3	42	589	7.6	—	—	—	—	—	—
	Maximum	1	7.15	—	—	—	—	—	13.9	4.3	42	589	7.6	—	—	—	—	—	—
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	1	1	1	—	0	0	0	0
1995 Near-surface measurements: summer																			
1. Main channel	Mean	0.2	4.1	0.38	—	—	—	—	27.1	9.39	120	486	8.6	59.9	16	22.6	7.2	39.3	55.4
	Median	0.2	3.68	0.41	—	—	—	—	27.3	9.15	117	483	8.6	60.5	16	22.5	7	36.7	54.9
	Minimum	0.2	0.9	0.05	—	—	—	—	25.4	7.9	98	464	8.4	35	12	13.1	4.6	32.5	34.1
	Maximum	0.2	10.8	0.7	—	—	—	—	28.1	11.3	146	514	8.7	76	25	37.9	11.1	51.3	80.9
	Std. dev.	0	2.1	0.18	—	—	—	—	0.77	0.85	12	17.4	0.08	11	2.9	5.63	1.43	8.27	13.2
	N obs.	26	26	26	0	0	0	0	26	26	26	26	26	26	26	26	26	26	4
2. Side channel	Mean	0.2	2.22	0.38	—	—	—	—	27.2	9.64	123	477	8.6	57.6	16	23.2	7	54.1	54.6
	Median	0.2	1.96	0.32	—	—	—	—	27.6	9.05	116	480	8.6	58	16	23.4	6.8	52	53.6
	Minimum	0.2	0.58	0.04	—	—	—	—	25.7	8.2	102	404	8.5	39	10	10	4.6	43.7	36.6
	Maximum	0.2	4.6	2.3	—	—	—	—	29.4	13.9	185	503	8.9	72	29	49.3	9.8	73.4	79.7
	Std. dev.	0	1.26	0.41	—	—	—	—	1.05	1.37	19.5	22.6	0.1	8.51	3.65	7.33	1.34	10.7	9.98
	N obs.	28	28	27	0	0	0	0	28	28	28	28	28	27	28	28	28	28	6
3. Backwater	Mean	0.2	0.75	0.07	—	—	—	—	27.7	10.3	133	469	8.5	42.9	22	36.5	9.6	62.5	72.7
	Median	0.2	0.58	0.02	—	—	—	—	27.5	9.8	124	475	8.6	43	19	28.6	7.9	42.8	61.4
	Minimum	0.2	0.24	0	—	—	—	—	24	3.9	50	304	7.3	17	11	13.9	3.6	26.1	23.3
	Maximum	0.2	3.2	0.46	—	—	—	—	32.1	25	351	521	9	70	56	316	48.4	163	221
	Std. dev.	0	0.57	0.11	—	—	—	—	1.74	3.28	47.2	38.3	0.3	12.3	9.72	40.8	6.16	37.6	37.2
	N obs.	59	59	58	0	0	0	0	59	59	59	59	59	59	41	58	59	59	15
5. Impounded	Mean	0.2	1.53	0.16	—	—	—	—	27.2	10	128	494	8.6	44.3	20	27.3	7.5	44.1	61.2
	Median	0.2	1.28	0.16	—	—	—	—	27.1	10	127	495	8.6	43	19	26.7	7.3	42.8	60.9
	Minimum	0.2	0.53	0	—	—	—	—	25.5	7.8	97	475	8.4	35	13	15	5	34.1	44.9
	Maximum	0.2	6.3	0.4	—	—	—	—	30.4	13.2	177	510	8.8	56	28	43	10	52.4	92.7
	Std. dev.	0	1.06	0.08	—	—	—	—	1.17	1.25	18.8	7.88	0.1	5.55	3.74	6.85	1.11	6.92	10.5
	N obs.	27	27	27	0	0	0	0	27	27	27	27	27	27	27	27	27	27	5

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1995 Near-surface measurements: summer																			
6. Isolated	Mean	0.2	1.55	0	—	—	—	—	24.1	4.1	50	840	7.7	124	17	43.1	29.5	38.3	44.7
	Median	0.2	0.5	0	—	—	—	—	24.3	2	24	760	7.6	124	21	19.4	15.2	26.1	11.7
	Minimum	0.2	0.35	0	—	—	—	—	21.7	0.2	2	553	7	113	3	3.2	3.2	3.74	1.71
	Maximum	0.2	6.71	0	—	—	—	—	26.3	13.9	172	1374	9.4	135	50	246	169	97.3	187
	Std. dev.	0	2.28	0	—	—	—	—	1.93	4.25	53	317	0.72	15.6	15.8	77.7	52.9	43.1	62.4
	N obs.	10	10	9	0	0	0	0	9	9	9	9	9	2	9	9	9	4	9
1995 Middepth measurements: summer																			
6. Isolated	Mean	3.5	6.71	—	—	—	—	—	18.7	0.28	3	597	7.3	—	—	—	—	—	—
	Median	3.5	6.71	—	—	—	—	—	18.8	0.1	1	599	7.3	—	—	—	—	—	—
	Minimum	2	6.71	—	—	—	—	—	12.5	0.1	1	557	7.1	—	—	—	—	—	—
	Maximum	5	6.71	—	—	—	—	—	24.9	0.8	10	635	7.5	—	—	—	—	—	—
	Std. dev.	1.29	0	—	—	—	—	—	5.61	0.35	4.36	35.3	0.17	—	—	—	—	—	—
	N obs.	4	4	0	—	—	—	—	4	4	4	4	4	—	0	0	0	0	0
1995 Near-bottom measurements: summer																			
6. Isolated	Mean	6.5	6.71	—	—	—	—	—	10.1	0.1	1	689	6.9	—	7	35	15.7	—	15.6
	Median	6.5	6.71	—	—	—	—	—	10.1	0.1	1	689	6.9	—	7	35	15.7	—	15.6
	Minimum	6.5	6.71	—	—	—	—	—	10.1	0.1	1	689	6.9	—	7	35	15.7	—	15.6
	Maximum	6.5	6.71	—	—	—	—	—	10.1	0.1	1	689	6.9	—	7	35	15.7	—	15.6
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	1	1	—	1	1	1	0	1
1995 Other measurements: summer																			
6. Isolated	Mean	1.25	6.71	—	—	—	—	—	25.5	3.2	39	553	7.6	—	—	—	—	—	—
	Median	1.25	6.71	—	—	—	—	—	25.5	3.2	39	553	7.6	—	—	—	—	—	—
	Minimum	1	6.71	—	—	—	—	—	25.3	2.3	28	552	7.5	—	—	—	—	—	—
	Maximum	1.5	6.71	—	—	—	—	—	25.7	4.1	51	554	7.7	—	—	—	—	—	—
	Std. dev.	0.35	0	—	—	—	—	—	0.28	1.27	15.9	1.41	0.14	—	—	—	—	—	—
	N obs.	2	2	0	—	—	—	—	2	2	2	2	2	—	0	0	0	0	0

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1995 Near-surface measurements: fall																			
1. Main channel	Mean	0.2	4.44	0.58	—	—	—	—	13.1	9.71	92	358	8.3	52.5	19	26.6	5.5	—	24.8
	Median	0.2	3.1	0.6	—	—	—	—	13.2	9.7	92	360	8.3	51	19	25.3	5.6	—	24.9
	Minimum	0.2	0.51	0.17	—	—	—	—	11.4	9	88	325	8.1	44	13	17.5	4.3	—	14.5
	Maximum	0.2	9.1	0.88	—	—	—	—	14.5	10.2	97	388	8.5	71	22	35.1	6.3	—	35.3
	Std. dev.	0	2.45	0.23	—	—	—	—	0.85	0.28	2.55	20	0.12	6.01	2.1	4.61	0.56	—	5.1
	N obs.	25	25	25	0	0	0	0	25	25	25	25	25	24	25	25	25	0	25
2. Side channel	Mean	0.2	2.61	0.43	—	—	—	—	13.3	9.59	92	334	8.2	51.8	18	24.9	5.2	14.4	22.9
	Median	0.2	2.28	0.44	—	—	—	—	13.3	9.6	91	334	8.2	50	18	22.5	5.1	15	22.6
	Minimum	0.2	0.65	0	—	—	—	—	10.9	9	83	230	7.8	42	10	8.9	3.3	11.2	11.3
	Maximum	0.2	6.5	0.76	—	—	—	—	16.1	10.1	102	388	8.5	74	27	40.9	7.1	17.1	36.3
	Std. dev.	0	1.48	0.17	—	—	—	—	1.45	0.29	3.72	36.7	0.14	7.46	3.66	7.82	0.88	2.98	7.32
	N obs.	30	30	30	0	0	0	0	30	30	30	30	30	28	30	30	30	3	30
3. Backwater	Mean	0.2	1.06	0.09	—	—	—	—	14	9.85	96	335	8.3	49.2	17	24.9	6.4	29.3	37.6
	Median	0.2	0.91	0	—	—	—	—	14	9.7	95	328	8.3	46	16	21.8	5.9	22.6	28.8
	Minimum	0.2	0.34	0	—	—	—	—	9.2	3.6	35	127	7.4	31	2	2.7	1.7	6.84	6.53
	Maximum	0.2	4.2	0.69	—	—	—	—	17.5	14.1	140	494	9.2	85	42	62.3	13	61.6	97.8
	Std. dev.	0	0.64	0.16	—	—	—	—	1.96	1.83	19.3	65.5	0.39	11.6	7.93	14.1	2.58	22.4	22.2
	N obs.	60	60	60	0	0	0	0	60	60	60	60	60	47	60	60	60	7	60
5. Impounded	Mean	0.2	1.48	0.21	—	—	—	—	14.5	9.94	98	335	8.4	45.8	19	29.3	5.7	28.5	31
	Median	0.2	1.33	0.21	—	—	—	—	14.8	9.8	98	326	8.4	46	18	28.7	5.8	26.7	31.3
	Minimum	0.2	0.5	0.08	—	—	—	—	12.9	9.1	88	276	8.2	38	15	21.1	4.9	26.3	14.7
	Maximum	0.2	3.9	0.46	—	—	—	—	16.3	11.2	107	380	8.7	56	26	41.5	6.6	32.4	38
	Std. dev.	0	0.68	0.07	—	—	—	—	1.23	0.57	5.38	23.9	0.14	5.03	3.23	5.24	0.48	3.4	5.44
	N obs.	25	25	25	0	0	0	0	25	25	25	25	25	25	25	25	25	3	25
6. Isolated	Mean	0.2	0.51	0	—	—	—	—	9.83	5.08	45	822	7.7	75	5	5.7	4	6.91	21.7
	Median	0.2	0.47	0	—	—	—	—	8.95	4.35	37	817	7.7	75	5	5.2	3.7	6.91	13.9
	Minimum	0.2	0.35	0	—	—	—	—	7.9	2.1	18	538	7.4	75	2	2.4	2.2	3.42	2.34
	Maximum	0.2	0.9	0	—	—	—	—	13.5	8.9	85	1163	8.3	75	12	11.7	6.9	10.4	79.8
	Std. dev.	0	0.17	0	—	—	—	—	1.92	2.65	24.4	227	0.33	—	2.82	3.07	1.64	4.93	22.8
	N obs.	10	10	10	0	0	0	0	10	10	10	10	10	1	10	10	10	2	10

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1995 Near-bottom measurements: fall																			
2. Side channel	Mean	1.4	1.6	—	—	—	—	—	11.7	9	83	324	8	—	—	—	—	—	—
	Median	1.4	1.6	—	—	—	—	—	11.7	9	83	324	8	—	—	—	—	—	—
	Minimum	1.4	1.6	—	—	—	—	—	11.7	9	83	324	8	—	—	—	—	—	—
	Maximum	1.4	1.6	—	—	—	—	—	11.7	9	83	324	8	—	—	—	—	—	—
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	1	1	—	0	0	0	0	0
3. Backwater	Mean	0.89	1.08	—	—	—	—	—	13.6	10.3	99	360	8.4	—	—	—	—	—	—
	Median	0.75	0.95	—	—	—	—	—	13.9	10.3	97	357	8.4	—	—	—	—	—	—
	Minimum	0.4	0.59	—	—	—	—	—	9.2	4.6	44	153	7.4	—	—	—	—	—	—
	Maximum	4	4.2	—	—	—	—	—	17.5	14	140	494	9.2	—	—	—	—	—	—
	Std. dev.	0.64	0.65	—	—	—	—	—	2.49	1.85	20.5	70.2	0.44	—	—	—	—	—	—
	N obs.	28	28	0	—	—	—	—	28	28	28	28	28	—	0	0	0	0	0
6. Isolated	Mean	0.35	0.55	—	—	—	—	—	8.75	3.9	33	1108	7.7	—	—	—	—	—	—
	Median	0.35	0.55	—	—	—	—	—	8.75	3.9	33	1108	7.7	—	—	—	—	—	—
	Minimum	0.3	0.5	—	—	—	—	—	8.6	0.2	2	1054	7.4	—	—	—	—	—	—
	Maximum	0.4	0.6	—	—	—	—	—	8.9	7.6	65	1162	7.9	—	—	—	—	—	—
	Std. dev.	0.07	0.07	—	—	—	—	—	0.21	5.23	44.8	76.4	0.35	—	—	—	—	—	—
	N obs.	2	2	0	—	—	—	—	2	2	2	2	2	—	0	0	0	0	0
1996 Near-surface measurements: winter																			
1. Main channel	Mean	0.2	3.91	0.24	99.8	32	99	12	0.01	9.62	66	437	7.7	154	3	2.3	1.1	-1	0
	Median	0.2	4	0.26	100	32	100	11	0	9.6	66	437	7.7	153	3	1.9	1	-1	0
	Minimum	0.2	0.6	0.05	95	13	95	0	0	8.8	60	402	7.5	107	2	1.4	0.8	-1	0
	Maximum	0.2	9.45	0.4	100	55	100	31	0.2	10.6	72	481	7.9	268	4	6.2	1.5	-1	0
	Std. dev.	0	2.19	0.08	1	7.99	1.91	9.7	0.04	0.39	2.67	19.3	0.11	37.2	0.71	1.16	0.18	0	0
	N obs.	25	25	25	25	25	25	25	25	25	25	25	25	21	25	25	25	4	25
2. Side channel	Mean	0.2	2.34	0.15	100	38	95	10	0.01	9.3	64	435	7.7	135	3	2.3	1.1	—	0
	Median	0.2	2.25	0.16	100	41	100	9	0	9.3	64	430	7.7	136	3	2.3	1	—	0
	Minimum	0.2	0.68	0	99	18	20	0	0	8.3	57	407	7.3	62	2	1.3	0.7	—	0
	Maximum	0.2	4.3	0.26	100	57	100	29	0.1	10.3	70	468	8	168	4	3.7	2.6	—	0
	Std. dev.	0	1.11	0.06	0.19	10.1	18.2	7.7	0.04	0.4	2.75	18	0.16	25.2	0.71	0.65	0.35	—	0
	N obs.	29	29	29	29	29	29	29	29	29	29	29	29	19	29	29	29	0	29

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1996 Near-surface measurements: winter																			
3. Backwater	Mean	0.14	0.96	0.06	99.9	42	92	12	0.15	6.82	47	489	7.6	85.7	10	8	3	4.15	4.49
	Median	0.2	0.76	0.01	100	43	100	12	0.1	8.7	59	426	7.6	77.5	4	2.7	1.3	-1	0
	Minimum	0	0.42	0	95	19	20	0	-0.1	0	0	341	7	24	2	-0.1	-0.1	-1	0
	Maximum	0.2	4.27	0.28	100	60	100	35	1	10.2	70	1011	7.8	204	120	107	26.3	22.5	60.7
	Std. dev.	0.08	0.69	0.08	0.73	7.13	20.9	9.7	0.25	3.65	25	154	0.25	42.5	20.9	19.1	5.34	10.3	13.3
	N obs.	49	49	35	48	48	48	44	49	49	49	49	49	18	41	42	42	5	43
5. Impounded	Mean	0.2	1.47	0.1	100	42	100	17	0	9.37	64	429	7.8	125	3	1.9	1	-1	0
	Median	0.2	1.26	0.1	100	44	100	18	0	9.45	65	437	7.8	122	3	1.8	1	-1	0
	Minimum	0.1	0.72	0.01	100	26	100	7	0	8.1	55	250	7.6	97	3	1.2	0.7	-1	0
	Maximum	0.2	4	0.15	100	48	100	24	0	9.7	66	462	8.1	146	4	3.2	1.5	-1	0
	Std. dev.	0.02	0.76	0.03	0	6.01	0	4.3	0	0.41	2.8	42.5	0.16	16.6	0.49	0.41	0.21	0	0
	N obs.	22	22	22	22	22	22	22	22	22	22	22	22	9	22	22	22	5	22
6. Isolated	Mean	0.11	0.58	0	99.9	35	100	17	0.46	0.6	4	1401	7.1	37	42	36.3	18.3	17.1	39.4
	Median	0.1	0.64	0	100	37	100	24	0.3	0.5	4	1214	7	36	39	26.3	16.8	17.1	22.6
	Minimum	0	0.42	0	99	15	100	5	-0.1	0.2	1	671	6.9	30	19	22	12.6	17.1	4.3
	Maximum	0.2	0.68	0	100	43	100	27	1.5	1.3	9	2230	7.3	46	77	63.3	25.3	17.1	85.1
	Std. dev.	0.09	0.11	0	0.38	10	0	10	0.56	0.34	2.32	638	0.2	8.25	21.6	18.1	5.22	—	34.2
	N obs.	7	7	6	7	7	7	7	7	7	7	7	7	4	5	5	5	1	5
1996 Middepth measurements: winter																			
3. Backwater	Mean	0.77	1.67	—	—	—	—	—	0.37	7.53	52	392	7.6	—	—	—	—	—	—
	Median	0.4	1.06	—	—	—	—	—	0.1	8.3	57	411	7.8	—	—	—	—	—	—
	Minimum	0.4	1	—	—	—	—	—	0	6	42	355	7.3	—	—	—	—	—	—
	Maximum	1.5	2.95	—	—	—	—	—	1	8.3	57	411	7.8	—	—	—	—	—	—
	Std. dev.	0.64	1.11	—	—	—	—	—	0.55	1.33	8.44	32.3	0.29	—	—	—	—	—	—
	N obs.	3	3	0	—	—	—	—	3	3	3	3	3	—	0	0	0	0	0
1996 Near-bottom measurements: winter																			
2. Side channel	Mean	1	1.2	—	—	—	—	—	0	9.1	62	419	7.8	—	—	—	—	—	—
	Median	1	1.2	—	—	—	—	—	0	9.1	62	419	7.8	—	—	—	—	—	—
	Minimum	1	1.2	—	—	—	—	—	0	9.1	62	419	7.8	—	—	—	—	—	—
	Maximum	1	1.2	—	—	—	—	—	0	9.1	62	419	7.8	—	—	—	—	—	—
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	1	1	—	0	0	0	0	0

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1996 Near-bottom measurements: winter																			
3. Backwater	Mean	1.43	1.62	—	—	—	—	—	0.43	7.07	49	433	7.6	—	9	4.6	2.1	—	0
	Median	1.2	1.4	—	—	—	—	—	0.2	8.9	61	446	7.6	—	9	4.6	2.1	—	0
	Minimum	0.7	0.9	—	—	—	—	—	0.1	1.2	9	332	7.2	—	9	4.6	2.1	—	0
	Maximum	2.8	2.95	—	—	—	—	—	1.4	9.6	66	524	7.7	—	9	4.6	2.1	—	0
	Std. dev.	0.75	0.74	—	—	—	—	—	0.48	3.12	21.2	60.5	0.19	—	—	—	—	—	—
	N obs.	7	7	0	—	—	—	—	7	7	7	7	7	7	—	1	1	1	0
1996 Near-surface measurements: spring																			
1. Main channel	Mean	0.2	4.91	0.82	—	—	—	—	9.42	11.8	103	253	8.4	67.8	15	24.9	5.8	40.4	42.4
	Median	0.2	4.6	0.8	—	—	—	—	9.3	11.8	103	254	8.4	68	13	21.6	5.2	41.7	42.8
	Minimum	0.2	1.65	0.31	—	—	—	—	8.5	11.2	96	204	8	53	11	16.2	4.3	33.4	31.3
	Maximum	0.2	8.3	1.42	—	—	—	—	11.1	12.6	115	296	8.8	76	25	50.5	12.4	46.2	51.5
	Std. dev.	0	1.96	0.3	—	—	—	—	0.71	0.32	3.76	25.1	0.19	6.32	3.88	8.86	1.72	6.51	4.86
	N obs.	25	25	24	0	0	0	0	25	25	25	25	25	25	25	25	25	25	3
2. Side channel	Mean	0.2	3	0.63	—	—	—	—	9.82	12.1	107	243	8.5	64.5	15	25.7	5.6	36.4	42.7
	Median	0.2	2.96	0.65	—	—	—	—	9.7	12.1	107	230	8.5	65	13	20.6	5.2	36.4	43.3
	Minimum	0.2	0.94	0.11	—	—	—	—	8.6	10.9	97	193	8	50	11	1.9	0.5	32.3	31.3
	Maximum	0.2	6.4	1.2	—	—	—	—	11	13.2	119	295	8.9	79	29	58.1	9.1	40.6	57
	Std. dev.	0	1.3	0.27	—	—	—	—	0.75	0.59	6.38	31.1	0.24	7.98	4.28	12.1	1.53	5.92	7.37
	N obs.	31	31	31	0	0	0	0	31	30	30	31	31	31	31	31	31	31	2
3. Backwater	Mean	0.2	1.91	0.16	—	—	—	—	9.91	12.8	113	259	8.6	74.3	10	15.2	5.1	40	47
	Median	0.2	1.43	0.07	—	—	—	—	10	12.6	112	238	8.6	71	10	13.3	4.9	37.6	43.6
	Minimum	0.2	0.48	0	—	—	—	—	7.8	11.1	96	185	8	38	3	-0.1	2.9	19.7	23.8
	Maximum	0.2	13.2	0.75	—	—	—	—	11.3	14.9	136	489	9.5	131	22	49.3	9.5	62	104
	Std. dev.	0	1.72	0.2	—	—	—	—	0.93	0.89	9.25	66.9	0.24	14.8	3.78	7.89	1.09	15.9	14.1
	N obs.	59	59	58	0	0	0	0	59	59	59	59	59	55	59	59	59	55	5
5. Impounded	Mean	0.2	1.73	0.35	—	—	—	—	10.1	12.2	108	249	8.6	61.5	16	30.6	6.3	42.1	47.3
	Median	0.2	1.65	0.35	—	—	—	—	10.3	12.2	108	259	8.7	62	15	26.8	6.3	42.7	47.3
	Minimum	0.2	0.9	0.12	—	—	—	—	9	11.1	97	192	8	52	9	19.3	4.2	40.9	37.5
	Maximum	0.2	2.74	0.6	—	—	—	—	11.2	13.3	120	304	8.8	70	30	74.2	9.9	42.8	60.8
	Std. dev.	0	0.47	0.11	—	—	—	—	0.65	0.55	5.84	30.3	0.26	5.44	4.38	13.1	1.17	1.05	5.37
	N obs.	25	25	25	0	0	0	0	25	25	25	25	25	25	25	25	25	25	3

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1996 Near-surface measurements: spring																			
6. Isolated	Mean	0.2	2.03	0	—	—	—	—	12.6	18	170	289	9.4	57.7	10	19.7	11.2	85.7	98.4
	Median	0.2	1.32	0	—	—	—	—	12.6	19.5	188	290	9.5	57	9	18.6	11.7	85.7	98.6
	Minimum	0.2	1.06	0	—	—	—	—	11.4	2.5	24	277	8.8	50	8	13.2	5.6	57.7	65.5
	Maximum	0.2	8.84	0	—	—	—	—	14	25	237	302	9.7	69	14	28.5	14.9	114	132
	Std. dev.	0	2.4	0	—	—	—	—	0.83	6.51	62.2	8.55	0.31	5.87	2.28	5.1	3.13	39.5	23.2
	N obs.	10	10	10	0	0	0	0	10	10	10	10	10	10	10	10	10	2	10
1996 Middepth measurements: spring																			
6. Isolated	Mean	4.4	8.84	—	—	—	—	—	10.6	12.2	110	280	8.6	—	—	—	—	—	—
	Median	4.4	8.84	—	—	—	—	—	10.6	12.2	110	280	8.6	—	—	—	—	—	—
	Minimum	4.4	8.84	—	—	—	—	—	10.6	12.2	110	280	8.6	—	—	—	—	—	—
	Maximum	4.4	8.84	—	—	—	—	—	10.6	12.2	110	280	8.6	—	—	—	—	—	—
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	1	1	—	0	0	0	0	0
1996 Near-bottom measurements: spring																			
3. Backwater	Mean	1.55	1.76	—	—	—	—	—	9.87	12.9	114	270	8.6	—	—	—	—	—	—
	Median	1.4	1.56	—	—	—	—	—	10.2	13.2	117	247	8.6	—	—	—	—	—	—
	Minimum	0.5	0.71	—	—	—	—	—	8.2	11.2	95	186	8	—	—	—	—	—	—
	Maximum	3	3.2	—	—	—	—	—	11.1	15	136	488	9.5	—	—	—	—	—	—
	Std. dev.	0.8	0.8	—	—	—	—	—	0.99	1.04	11.2	86.9	0.35	—	—	—	—	—	—
	N obs.	17	17	0	—	—	—	—	17	17	17	17	17	—	0	0	0	0	0
6. Isolated	Mean	1.92	2.12	—	—	—	—	—	11.5	17.3	159	294	9.2	—	10	15.1	5.2	—	43.8
	Median	1.1	1.33	—	—	—	—	—	11.6	18.8	178	297	9.3	—	10	15.1	5.2	—	43.8
	Minimum	0.9	1.06	—	—	—	—	—	9.3	10.4	91	279	8.3	—	10	15.1	5.2	—	43.8
	Maximum	8.6	8.84	—	—	—	—	—	13	20.7	193	315	9.7	—	10	15.1	5.2	—	43.8
	Std. dev.	2.51	2.52	—	—	—	—	—	1.07	3.69	36.5	11.3	0.49	—	—	—	—	—	—
	N obs.	9	9	0	—	—	—	—	9	9	9	9	9	—	1	1	1	0	1

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1996 Near-surface measurements: summer																			
1. Main channel	Mean	0.2	4.65	0.38	—	—	—	—	23.7	8.3	99	398	8.4	62.1	12	17.1	5.3	19.4	23.7
	Median	0.2	4.5	0.32	—	—	—	—	23.8	8.4	99	396	8.4	63	12	16.3	5.4	20.3	24.6
	Minimum	0.2	1.2	0.14	—	—	—	—	22.4	7.2	83	355	8.2	40	9	10.7	3	11.3	10.9
	Maximum	0.2	8.9	0.69	—	—	—	—	24.9	9.2	111	438	8.6	78	21	29.7	7	25.6	36.2
	Std. dev.	0	2.2	0.18	—	—	—	—	0.63	0.56	7.24	29.5	0.11	11.9	2.38	4.34	0.9	6.08	6.11
	N obs.	25	25	22	0	0	0	0	25	25	25	25	25	25	25	25	25	4	25
2. Side channel	Mean	0.2	2.09	0.27	—	—	—	—	24	8.46	101	398	8.4	58.5	13	19.4	5.4	23.1	23.5
	Median	0.2	1.61	0.23	—	—	—	—	24.2	8.55	103	395	8.4	58	13	19	5.4	23.1	23
	Minimum	0.2	0.42	0.1	—	—	—	—	22.6	7.3	85	366	8.1	35	10	10.9	3.4	23.1	11.3
	Maximum	0.2	5.3	0.52	—	—	—	—	25	10.3	125	428	8.7	76	22	34.9	6.7	23.1	36.2
	Std. dev.	0	1.43	0.12	—	—	—	—	0.58	0.72	9.24	20.1	0.14	9.75	2.51	4.99	0.81	—	5.51
	N obs.	30	30	24	0	0	0	0	30	30	30	30	30	25	30	30	30	1	30
3. Backwater	Mean	0.18	0.66	0.04	—	—	—	—	25	9.31	114	397	8.4	41.5	21	34.1	9.3	50.1	43.1
	Median	0.2	0.5	0.01	—	—	—	—	24.8	9.25	112	398	8.5	40	17	27	7.3	29.5	25.9
	Minimum	0.1	0.22	0	—	—	—	—	22	2.5	29	302	7.4	8	3	11	4.1	10.4	2.28
	Maximum	0.2	5.18	0.25	—	—	—	—	28.3	25	324	473	9.4	68	94	120	36	169	342
	Std. dev.	0.04	0.82	0.06	—	—	—	—	1.25	3.77	48.7	36.8	0.37	12.6	14.6	21.9	5.59	67.3	50
	N obs.	60	60	51	0	0	0	0	60	60	60	60	60	30	60	60	60	5	60
5. Impounded	Mean	0.2	1.53	0.13	—	—	—	—	23.7	8.26	98	379	8.4	51.8	17	22.4	5.7	23.1	23.4
	Median	0.2	1.45	0.12	—	—	—	—	23.7	8.1	97	374	8.4	50	16	19.2	6	23.6	22.2
	Minimum	0.2	0.5	0.06	—	—	—	—	22.3	7.6	89	369	8.3	30	11	14.4	4.3	17.1	14.7
	Maximum	0.2	3.3	0.26	—	—	—	—	25.5	10.4	128	424	8.6	75	27	38.6	7.2	28.3	36.8
	Std. dev.	0	0.73	0.05	—	—	—	—	0.62	0.56	7.73	13.5	0.08	11.4	4.13	7	0.87	5.2	5.52
	N obs.	25	25	23	0	0	0	0	25	25	25	25	25	24	25	25	25	4	25
6. Isolated	Mean	0.2	1.22	0.01	—	—	—	—	21.1	1.71	20	627	7.4	160	13	53.6	22.9	81.4	45
	Median	0.2	0.55	0	—	—	—	—	20.6	0.55	6	564	7.3	160	8	16.4	12.1	81.4	10.4
	Minimum	0.2	0.29	0	—	—	—	—	18.3	0.3	3	423	7.1	160	3	3.3	4	81.4	0
	Maximum	0.2	7.9	0.06	—	—	—	—	24.6	6.5	79	930	7.9	160	40	321	89.4	81.4	226
	Std. dev.	0	2.35	0.02	—	—	—	—	1.93	2.28	27.5	168	0.3	—	11.9	97.8	26.6	—	70.7
	N obs.	10	10	10	0	0	0	0	10	10	10	10	10	1	10	10	10	1	10

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1996 Middepth measurements: summer																			
6. Isolated	Mean	4.5	7.9	—	—	—	—	—	11.1	0.1	1	560	7.2	—	13	18.7	11.4	—	100
	Median	4.5	7.9	—	—	—	—	—	11.1	0.1	1	560	7.2	—	13	18.7	11.4	—	100
	Minimum	4	7.9	—	—	—	—	—	9.7	0.1	1	557	7.2	—	13	18.7	11.4	—	100
	Maximum	5	7.9	—	—	—	—	—	12.4	0.1	1	563	7.2	—	13	18.7	11.4	—	100
	Std. dev.	0.71	0	—	—	—	—	—	1.91	0	0.04	4.24	0	—	—	—	—	—	—
	N obs.	2	2	0	—	—	—	—	2	2	2	2	2	—	1	1	1	0	1
1996 Near-bottom measurements: summer																			
3. Backwater	Mean	1.08	1.29	—	—	—	—	—	24.5	9.02	109	361	8.5	—	—	—	—	—	—
	Median	0.7	0.88	—	—	—	—	—	24.4	9.1	108	344	8.4	—	—	—	—	—	—
	Minimum	0.4	0.65	—	—	—	—	—	23.7	7.4	90	320	8.2	—	—	—	—	—	—
	Maximum	5	5.18	—	—	—	—	—	25.3	11.4	139	425	8.9	—	—	—	—	—	—
	Std. dev.	1.48	1.47	—	—	—	—	—	0.59	1.36	16.5	35.8	0.21	—	—	—	—	—	—
	N obs.	9	9	0	—	—	—	—	9	9	9	9	9	—	0	0	0	0	0
6. Isolated	Mean	7.7	7.9	—	—	—	—	—	6.8	0.2	2	974	7	—	8	40.8	12.6	—	13.4
	Median	7.7	7.9	—	—	—	—	—	6.8	0.2	2	974	7	—	8	40.8	12.6	—	13.4
	Minimum	7.7	7.9	—	—	—	—	—	6.8	0.2	2	974	7	—	8	40.8	12.6	—	13.4
	Maximum	7.7	7.9	—	—	—	—	—	6.8	0.2	2	974	7	—	8	40.8	12.6	—	13.4
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	1	1	—	1	1	1	0	1
1996 Near-surface measurements: fall																			
1. Main channel	Mean	0.2	4.22	0.21	—	—	—	—	13.3	15.4	147	347	9.3	56.9	13	24.9	8.8	142	139
	Median	0.2	4.1	0.17	—	—	—	—	13.6	14.8	143	343	9.2	58	11	20.9	8	121	127
	Minimum	0.2	0.9	0.1	—	—	—	—	12.1	12.2	115	331	9	35	7	15.4	6.4	90.1	83.1
	Maximum	0.2	8	0.36	—	—	—	—	14.2	18.2	175	362	9.6	72	22	41.2	12.7	193	199
	Std. dev.	0	1.9	0.08	—	—	—	—	0.64	2.2	22.2	8.71	0.22	10.6	4.97	8.68	2.15	45.9	38.5
	N obs.	25	25	23	0	0	0	0	25	25	25	25	25	25	25	25	25	5	25
2. Side channel	Mean	0.2	2.13	0.11	—	—	—	—	13.2	15.8	151	342	9.3	56.3	14	27.5	9.1	108	130
	Median	0.2	1.84	0.12	—	—	—	—	13.4	15.4	145	342	9.3	57.5	12	24.4	8.9	108	119
	Minimum	0.1	0.26	0	—	—	—	—	11.6	12.6	121	302	9.1	34	8	16.4	5.5	108	78.6
	Maximum	0.2	6	0.24	—	—	—	—	15.6	25	245	363	9.7	75	23	54	14.3	108	203
	Std. dev.	0.02	1.33	0.06	—	—	—	—	0.8	2.43	24.8	11.2	0.16	10.7	4.37	9.24	2.14	—	30.8
	N obs.	30	30	28	0	0	0	0	30	30	30	30	30	28	30	30	30	1	30

Table F-1. Continued.

Sampling stratum	Statistic	Sample depth (m)	Water depth (m)	Water velocity (m/s)	Ice cover (%)	Thickness of ice (cm)	Snow cover (%)	Snow depth (cm)	Water temp. (°C)	Dissolved oxygen (mg/L)	Oxygen saturation (%)	Specific cond. (µS)	pH	Secchi depth (cm)	Turbidity (NTU)	Total suspended solids (mg/L)	Volatile suspended solids (mg/L)	Spectr. chl. (µg/L)	Fluor. chl. (µg/L)
1996 Near-surface measurements: fall																			
3. Backwater	Mean	0.19	0.68	0.03	—	—	—	—	13.2	15	144	356	9.2	48.3	15	29.5	9.3	91.2	94.9
	Median	0.2	0.46	0.02	—	—	—	—	13.2	15.2	143	343	9.3	45	13	24.1	8.7	85.1	109
	Minimum	0.1	0.17	0	—	—	—	—	10.8	6.8	64	307	7	23	1	1.3	1.3	5.28	0.57
	Maximum	0.2	2.32	0.22	—	—	—	—	17.2	25	255	499	9.9	68	111	243	40.1	188	194
	Std. dev.	0.03	0.52	0.05	—	—	—	—	1.22	3.66	37.6	36.6	0.49	11.9	14.7	35	5.72	68.5	52.4
	N obs.	60	60	60	0	0	0	0	60	60	60	60	60	26	60	60	60	5	60
5. Impounded	Mean	0.2	1.26	0.07	—	—	—	—	13.5	17.2	165	342	9.4	47.7	21	45.9	11.4	133	155
	Median	0.2	1.25	0.07	—	—	—	—	13.5	16.9	162	342	9.3	45	19	34.6	11.2	136	147
	Minimum	0.2	0.69	0.02	—	—	—	—	12	13.8	132	327	9	31	10	21.3	7	111	110
	Maximum	0.2	2.01	0.13	—	—	—	—	15.4	25	250	360	9.8	66	50	145	18.9	149	208
	Std. dev.	0	0.33	0.03	—	—	—	—	0.62	2.73	28.5	8.57	0.21	9.95	9.42	29.6	3.04	14.4	34
	N obs.	25	25	24	0	0	0	0	25	25	25	25	25	25	25	25	25	5	25
6. Isolated	Mean	0.18	0.35	0	—	—	—	—	10.5	7.37	66	990	7.8	—	7	9.7	6.3	25.7	31.8
	Median	0.2	0.35	0	—	—	—	—	10.7	8.35	75	874	7.8	—	5	7	5.4	25.7	30.2
	Minimum	0.1	0.17	0	—	—	—	—	8.3	1.9	18	566	7.3	—	3	5.6	4.3	25.7	3.63
	Maximum	0.2	0.44	0	—	—	—	—	12.6	10.6	100	1541	8.2	—	14	23.9	15.9	25.7	72.1
	Std. dev.	0.04	0.09	0	—	—	—	—	1.53	2.87	26.5	356	0.28	—	3.69	5.81	3.45	—	17.8
	N obs.	10	10	10	0	0	0	0	10	10	10	10	10	0	10	10	10	1	10
1996 Middepth measurements: fall																			
3. Backwater	Mean	0.7	1.46	—	—	—	—	—	12.1	15.2	141	400	9.2	—	—	—	—	—	—
	Median	0.7	1.46	—	—	—	—	—	12.1	15.2	141	400	9.2	—	—	—	—	—	—
	Minimum	0.7	1.46	—	—	—	—	—	12.1	15.2	141	400	9.2	—	—	—	—	—	—
	Maximum	0.7	1.46	—	—	—	—	—	12.1	15.2	141	400	9.2	—	—	—	—	—	—
	Std. dev.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	N obs.	1	1	0	—	—	—	—	1	1	1	1	1	—	0	0	0	0	0
1996 Near-bottom measurements: fall																			
3. Backwater	Mean	0.96	1.16	—	—	—	—	—	13.1	13.6	130	362	9	—	19	30.1	9.2	—	88
	Median	0.95	1.15	—	—	—	—	—	13.3	14.2	132	358	9	—	19	30.1	9.2	—	88
	Minimum	0.4	0.65	—	—	—	—	—	10.8	9.9	94	336	8.7	—	19	30.1	9.2	—	88
	Maximum	1.5	1.73	—	—	—	—	—	14.2	16.3	159	422	9.3	—	19	30.1	9.2	—	88
	Std. dev.	0.44	0.43	—	—	—	—	—	1.02	2.45	24	26.4	0.23	—	—	—	—	—	—
	N obs.	8	8	0	—	—	—	—	8	8	8	8	8	—	1	1	1	0	1

Table F-2. Summaries of chemical measurements during each stratified random sampling episode from 1993 through 1996. Data are grouped into three sampling-depth categories: near surface (less than 0.2 m below the surface), middepth, and near bottom (less than 0.2 m above the substrate).

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1993 Near-surface measurements: summer													
1. Main channel	Mean	3.4	0.061	2.255	0.228	0.191	—	—	—	—	—	—	—
	Median	3.341	0.058	2.167	0.229	0.191	—	—	—	—	—	—	—
	Minimum	2.726	0.042	1.848	0.205	0.176	—	—	—	—	—	—	—
	Maximum	4.156	0.08	2.794	0.252	0.204	—	—	—	—	—	—	—
	Std. dev.	0.503	0.011	0.28	0.013	0.007	—	—	—	—	—	—	—
	N obs.	13	13	13	13	13	0	0	0	0	0	0	0
2. Side channel	Mean	3.514	0.062	2.218	0.228	0.189	—	—	—	—	—	—	—
	Median	3.54	0.057	2.115	0.223	0.189	—	—	—	—	—	—	—
	Minimum	2.545	0.043	1.778	0.198	0.178	—	—	—	—	—	—	—
	Maximum	4.653	0.094	2.922	0.28	0.202	—	—	—	—	—	—	—
	Std. dev.	0.572	0.013	0.356	0.02	0.007	—	—	—	—	—	—	—
	N obs.	16	16	16	16	16	0	0	0	0	0	0	0
3. Backwater	Mean	3.497	0.073	2.128	0.213	0.182	—	—	—	—	—	—	—
	Median	3.296	0.064	2.096	0.211	0.187	—	—	—	—	—	—	—
	Minimum	1.594	0.038	0.669	0.154	0.112	—	—	—	—	—	—	—
	Maximum	11.32	0.311	3.768	0.311	0.278	—	—	—	—	—	—	—
	Std. dev.	1.61	0.048	0.561	0.029	0.03	—	—	—	—	—	—	—
	N obs.	31	31	31	31	31	0	0	0	0	0	0	0
5. Impounded	Mean	3.482	0.061	2.299	0.223	0.193	—	—	—	—	—	—	—
	Median	3.522	0.056	2.299	0.224	0.195	—	—	—	—	—	—	—
	Minimum	2.092	0.045	1.858	0.198	0.18	—	—	—	—	—	—	—
	Maximum	4.626	0.114	2.895	0.285	0.207	—	—	—	—	—	—	—
	Std. dev.	0.774	0.019	0.32	0.022	0.008	—	—	—	—	—	—	—
	N obs.	13	13	13	13	13	0	0	0	0	0	0	0
1993 Near-surface measurements: fall													
1. Main channel	Mean	4.39	0.043	1.626	0.174	0.113	—	—	—	—	—	—	—
	Median	3.408	0.046	1.594	0.176	0.116	—	—	—	—	—	—	—
	Minimum	2.764	-0.02	1.036	0.16	0.1	—	—	—	—	—	—	—
	Maximum	14.74	0.067	2.056	0.189	0.12	—	—	—	—	—	—	—
	Std. dev.	3.235	0.016	0.282	0.008	0.007	—	—	—	—	—	—	—
	N obs.	13	13	13	13	13	0	0	0	0	0	0	0

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1993 Near-surface measurements: fall													
2. Side channel	Mean	3.508	0.052	1.479	0.173	0.106	—	—	—	—	—	—	—
	Median	3.458	0.052	1.428	0.17	0.107	—	—	—	—	—	—	—
	Minimum	2.467	-0.02	0.32	0.132	0.086	—	—	—	—	—	—	—
	Maximum	4.552	0.091	2.22	0.252	0.124	—	—	—	—	—	—	—
	Std. dev.	0.565	0.027	0.428	0.025	0.01	—	—	—	—	—	—	—
	N obs.	16	16	16	16	16	0	0	0	0	0	0	0
3. Backwater	Mean	3.228	0.052	1.114	0.18	0.078	—	—	—	—	—	—	—
	Median	3.407	0.033	1.34	0.175	0.095	—	—	—	—	—	—	—
	Minimum	1.379	-0.02	-0.01	0.081	-0.01	—	—	—	—	—	—	—
	Maximum	4.519	0.169	2.199	0.285	0.122	—	—	—	—	—	—	—
	Std. dev.	0.809	0.043	0.737	0.037	0.039	—	—	—	—	—	—	—
	N obs.	31	32	32	32	32	0	0	0	0	0	0	0
5. Impounded	Mean	3.361	0.047	1.7	0.176	0.109	—	—	—	—	—	—	—
	Median	3.316	0.042	1.769	0.173	0.109	—	—	—	—	—	—	—
	Minimum	2.464	-0.02	1.291	0.165	0.1	—	—	—	—	—	—	—
	Maximum	5.049	0.083	1.897	0.193	0.117	—	—	—	—	—	—	—
	Std. dev.	0.651	0.024	0.212	0.008	0.006	—	—	—	—	—	—	—
	N obs.	12	12	12	12	12	0	0	0	0	0	0	0
1994 Near-surface measurements: winter													
1. Main channel	Mean	2.316	0.438	1.962	0.116	—	—	—	—	—	—	—	—
	Median	2.221	0.462	1.9	0.116	—	—	—	—	—	—	—	—
	Minimum	1.99	0.275	1.8	0.098	—	—	—	—	—	—	—	—
	Maximum	2.861	0.513	2.48	0.126	—	—	—	—	—	—	—	—
	Std. dev.	0.258	0.078	0.174	0.008	—	—	—	—	—	—	—	—
	N obs.	12	12	12	12	0	0	0	0	0	0	0	0
2. Side channel	Mean	2.482	0.425	2.156	0.114	—	—	—	—	—	—	—	—
	Median	2.366	0.436	1.98	0.114	—	—	—	—	—	—	—	—
	Minimum	1.812	0.24	1.81	0.097	—	—	—	—	—	—	—	—
	Maximum	4.121	0.567	3.85	0.134	—	—	—	—	—	—	—	—
	Std. dev.	0.595	0.102	0.532	0.011	—	—	—	—	—	—	—	—
	N obs.	13	13	13	13	0	0	0	0	0	0	0	0

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1994 Near-surface measurements: winter													
3. Backwater	Mean	2.708	0.4	1.717	0.109	—	—	—	—	—	—	—	—
	Median	2.313	0.349	1.87	0.116	—	—	—	—	—	—	—	—
	Minimum	0.836	0.177	0.51	0.056	—	—	—	—	—	—	—	—
	Maximum	7.321	0.842	2.09	0.136	—	—	—	—	—	—	—	—
	Std. dev.	1.617	0.149	0.48	0.025	—	—	—	—	—	—	—	—
	N obs.	16	16	16	16	0	0	0	0	0	0	0	0
5. Impounded	Mean	2.672	0.469	1.921	0.121	—	—	—	—	—	—	—	—
	Median	2.32	0.447	1.94	0.116	—	—	—	—	—	—	—	—
	Minimum	2.128	0.369	0.52	0.104	—	—	—	—	—	—	—	—
	Maximum	5.936	0.705	2.38	0.152	—	—	—	—	—	—	—	—
	Std. dev.	1.044	0.084	0.474	0.015	—	—	—	—	—	—	—	—
	N obs.	12	12	12	12	0	0	0	0	0	0	0	0
1994 Near-surface measurements: spring													
1. Main channel	Mean	2.284	0.028	1.884	0.115	0.02	3.349	—	—	—	—	10.12	35.91
	Median	2.305	-0.02	1.674	0.125	0.018	3.286	—	—	—	—	9.953	36.38
	Minimum	1.263	-0.02	1.03	0.078	-0.01	1.592	—	—	—	—	6.841	18.73
	Maximum	4.31	0.084	4.914	0.149	0.044	6.191	—	—	—	—	17.66	46.79
	Std. dev.	0.71	0.025	0.938	0.025	0.015	1.013	—	—	—	—	2.838	8.444
	N obs.	13	13	13	13	13	13	0	0	0	0	13	13
2. Side channel	Mean	1.942	0.028	1.29	0.112	0.019	3.098	—	—	—	—	7.978	32.3
	Median	1.813	-0.02	1.225	0.107	0.016	3.193	—	—	—	—	6.19	31.85
	Minimum	1.173	-0.02	0.54	0.081	-0.01	1.974	—	—	—	—	5.022	11.85
	Maximum	2.934	0.148	2.078	0.145	0.043	3.597	—	—	—	—	17.12	49.45
	Std. dev.	0.376	0.04	0.326	0.025	0.012	0.385	—	—	—	—	3.384	8.77
	N obs.	16	16	16	16	16	16	0	0	0	0	16	16
3. Backwater	Mean	1.868	0.033	1.253	0.108	0.017	2.836	—	—	—	—	11.35	37.25
	Median	1.813	-0.02	1.231	0.112	0.017	3.008	—	—	—	—	8.885	31.88
	Minimum	0.766	-0.02	0.18	0.052	-0.01	0.389	—	—	—	—	2.703	4.17
	Maximum	3.965	0.148	4.499	0.162	0.043	3.916	—	—	—	—	77.43	251.7
	Std. dev.	0.647	0.038	0.753	0.029	0.012	0.722	—	—	—	—	12.68	40.55
	N obs.	32	32	32	32	32	32	0	0	0	0	32	32

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1994 Near-surface measurements: spring													
5. Impounded	Mean	2.077	0.031	1.493	0.111	0.022	3.363	—	—	—	—	8.95	37.45
	Median	2.102	0.02	1.597	0.114	0.025	3.333	—	—	—	—	9.716	40.37
	Minimum	1.532	-0.02	0.98	0.078	-0.01	3.019	—	—	—	—	6.21	23.27
	Maximum	2.522	0.115	1.909	0.152	0.035	3.905	—	—	—	—	11.66	46.52
	Std. dev.	0.299	0.031	0.256	0.026	0.011	0.238	—	—	—	—	1.823	6.997
	N obs.	13	13	13	13	13	13	0	0	0	0	13	13
6. Isolated	Mean	1.508	0.019	0.566	0.071	0.019	1.515	—	—	—	—	13.19	24.87
	Median	1.777	0.022	0.714	0.075	-0.01	1.555	—	—	—	—	16.65	31.12
	Minimum	0.657	-0.02	0.241	0.049	-0.01	0.645	—	—	—	—	3.444	8.539
	Maximum	2.009	0.027	0.843	0.084	0.076	1.991	—	—	—	—	20.19	33.94
	Std. dev.	0.555	0.008	0.298	0.013	0.032	0.544	—	—	—	—	7.175	10.86
	N obs.	5	5	5	5	5	5	0	0	0	0	5	5
1994 Near-surface measurements: summer													
1. Main channel	Mean	2.087	0.01	1.212	0.153	0.041	6.23	—	—	—	—	9.33	38.49
	Median	2.119	-0.02	1.257	0.151	0.034	6.243	—	—	—	—	9.789	41.28
	Minimum	1.109	-0.02	0.669	0.104	-0.01	4.54	—	—	—	—	5.135	17.58
	Maximum	2.782	-0.02	1.529	0.204	0.101	7.62	—	—	—	—	11.73	51.88
	Std. dev.	0.414	0	0.229	0.033	0.026	0.771	—	—	—	—	1.982	9.005
	N obs.	14	14	14	14	14	14	0	0	0	0	14	14
2. Side channel	Mean	1.951	0.011	1.122	0.144	0.071	5.928	—	—	—	—	8.797	33.96
	Median	1.916	-0.02	1.062	0.14	0.05	6.014	—	—	—	—	9.167	36.93
	Minimum	1.543	-0.02	0.814	0.105	-0.01	4.987	—	—	—	—	5.158	16.36
	Maximum	3.176	0.02	1.495	0.201	0.334	6.845	—	—	—	—	10.84	44.45
	Std. dev.	0.392	0.002	0.196	0.028	0.078	0.418	—	—	—	—	1.785	8.508
	N obs.	17	17	17	17	17	17	0	0	0	0	17	17
3. Backwater	Mean	1.484	0.015	0.766	0.134	0.049	5.963	—	—	—	—	9.008	33.25
	Median	1.504	-0.02	0.822	0.122	0.046	5.743	—	—	—	—	9.549	37.12
	Minimum	0.622	-0.02	-0.01	0.041	-0.01	4.127	—	—	—	—	3.369	8.711
	Maximum	2.863	0.1	2.584	0.307	0.203	9.206	—	—	—	—	15	53.38
	Std. dev.	0.512	0.017	0.534	0.055	0.037	0.912	—	—	—	—	2.694	11.45
	N obs.	32	32	32	32	32	32	0	0	0	0	32	32

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1994 Near-surface measurements: summer													
5. Impounded	Mean	2.122	0.013	0.928	0.147	0.032	5.668	—	—	—	—	9.868	36.25
	Median	2.188	-0.02	0.852	0.147	0.024	5.755	—	—	—	—	10.71	39.18
	Minimum	1.543	-0.02	0.742	0.123	0.015	4.759	—	—	—	—	5.483	16.35
	Maximum	2.461	0.035	1.292	0.171	0.082	6.228	—	—	—	—	11.33	41.83
	Std. dev.	0.276	0.009	0.169	0.017	0.019	0.478	—	—	—	—	1.939	8.464
	N obs.	13	13	13	13	13	13	0	0	0	0	13	13
6. Isolated	Mean	1.579	0.015	0.005	0.455	0.14	1.831	—	—	—	—	26.42	2.827
	Median	1.333	-0.02	-0.01	0.442	0.134	1.247	—	—	—	—	13.17	1.16
	Minimum	0.885	-0.02	-0.01	0.102	0.037	-0.05	—	—	—	—	9.472	0.97
	Maximum	2.924	0.036	-0.01	0.754	0.253	5.412	—	—	—	—	55.34	6.537
	Std. dev.	0.785	0.012	0	0.235	0.099	2.083	—	—	—	—	21.21	2.523
	N obs.	5	5	5	5	5	5	0	0	0	0	5	5
1994 Near-surface measurements: fall													
1. Main channel	Mean	2.345	0.011	1.842	0.19	0.084	6.676	—	—	—	—	11.5	26.45
	Median	2.454	-0.02	1.9	0.151	0.08	6.631	—	—	—	—	11.38	26.15
	Minimum	1.134	-0.02	1.507	0.132	0.061	6.342	—	—	—	—	10.23	23.49
	Maximum	2.824	0.03	2.18	0.384	0.102	7.33	—	—	—	—	12.61	28.44
	Std. dev.	0.437	0.005	0.223	0.072	0.015	0.279	—	—	—	—	0.772	1.424
	N obs.	14	14	14	14	14	14	0	0	0	0	14	14
2. Side channel	Mean	2.339	0.015	1.753	0.219	0.086	6.203	—	—	—	—	11.21	23.8
	Median	2.327	-0.02	1.708	0.153	0.089	6.675	—	—	—	—	11.35	25.95
	Minimum	1.767	-0.02	1.257	0.119	0.062	0.119	—	—	—	—	9.656	0
	Maximum	2.996	0.035	3.355	0.702	0.116	7.553	—	—	—	—	12.3	28.78
	Std. dev.	0.338	0.009	0.47	0.151	0.016	1.681	—	—	—	—	0.812	6.461
	N obs.	17	17	17	17	17	17	0	0	0	0	17	17
3. Backwater	Mean	1.979	0.021	1.205	0.208	0.062	5.861	—	—	—	—	10.4	22.57
	Median	2.147	-0.02	1.52	0.15	0.066	6.7	—	—	—	—	11.01	24.96
	Minimum	0.952	-0.02	-0.01	0.047	-0.01	0.259	—	—	—	—	7.024	5.474
	Maximum	2.785	0.179	1.845	0.488	0.137	8.024	—	—	—	—	14.57	33.25
	Std. dev.	0.53	0.033	0.592	0.131	0.036	2.019	—	—	—	—	1.907	5.987
	N obs.	30	30	30	30	30	30	0	0	0	0	30	30

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1994 Near-surface measurements: fall													
5. Impounded	Mean	2.215	0.011	1.55	0.256	0.071	6.751	—	—	—	—	11.13	24.52
	Median	2.147	-0.02	1.566	0.233	0.068	6.704	—	—	—	—	10.65	24.53
	Minimum	1.831	-0.02	1.239	0.143	0.047	5.523	—	—	—	—	9.141	20.11
	Maximum	2.705	0.021	1.793	0.407	0.1	7.967	—	—	—	—	13.78	27.6
	Std. dev.	0.262	0.003	0.191	0.079	0.017	0.779	—	—	—	—	1.258	2.353
	N obs.	13	13	13	13	13	13	0	0	0	0	13	13
6. Isolated	Mean	1.698	0.188	0.068	0.51	0.255	1.156	—	—	—	—	60.17	6.161
	Median	1.806	-0.02	-0.01	0.24	0.037	0.278	—	—	—	—	51.82	6.377
	Minimum	1.132	-0.02	-0.01	0.099	0.015	0.221	—	—	—	—	45.06	1.561
	Maximum	1.943	0.78	0.322	1.569	1.137	3.494	—	—	—	—	87.27	11.41
	Std. dev.	0.323	0.335	0.142	0.617	0.493	1.426	—	—	—	—	16.89	4.353
	N obs.	5	5	5	5	5	5	0	0	0	0	5	5
1995 Near-surface measurements: winter													
1. Main channel	Mean	2.528	0.011	1.966	0.069	0.037	5.729	—	—	—	—	18.1	37.04
	Median	2.527	-0.02	1.914	0.073	0.043	6.21	—	—	—	—	18.14	36.49
	Minimum	2.29	-0.02	1.665	0.042	0.014	4.171	—	—	—	—	14	28.24
	Maximum	2.939	0.026	2.467	0.089	0.049	6.851	—	—	—	—	21.65	53.76
	Std. dev.	0.168	0.005	0.193	0.016	0.013	1.135	—	—	—	—	1.987	5.946
	N obs.	12	12	12	12	12	12	0	0	0	0	12	12
2. Side channel	Mean	2.515	0.024	1.909	0.078	0.032	5.715	—	—	—	—	17.12	34.08
	Median	2.54	-0.02	1.847	0.077	0.037	6.409	—	—	—	—	16.97	34.54
	Minimum	2.296	-0.02	1.712	0.044	0.014	4.141	—	—	—	—	13.27	29.22
	Maximum	2.92	0.105	2.244	0.121	0.05	7.105	—	—	—	—	19.92	37.49
	Std. dev.	0.172	0.029	0.158	0.021	0.012	1.164	—	—	—	—	1.697	2.726
	N obs.	13	13	13	13	13	13	0	0	0	0	13	13
3. Backwater	Mean	2.414	0.019	1.753	0.075	0.034	5.865	—	—	—	—	17.21	33.66
	Median	2.482	-0.02	1.864	0.085	0.038	6.325	—	—	—	—	16.93	34.43
	Minimum	1.4	-0.02	0.379	0.044	-0.01	-0.05	—	—	—	—	14.45	24.09
	Maximum	2.698	0.062	2.055	0.106	0.048	7.711	—	—	—	—	21.06	40.23
	Std. dev.	0.276	0.016	0.359	0.019	0.013	1.737	—	—	—	—	1.384	3.551
	N obs.	19	18	18	19	19	19	0	0	0	0	19	19

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1995 Near-surface measurements: winter													
5. Impounded	Mean	2.572	0.016	1.905	0.075	0.035	6.128	—	—	—	—	17.17	33.93
	Median	2.553	-0.02	1.9	0.083	0.039	6.536	—	—	—	—	16.65	33.35
	Minimum	2.405	-0.02	1.72	0.054	0.019	4.141	—	—	—	—	14.36	31.09
	Maximum	2.812	0.042	2.12	0.095	0.047	7.359	—	—	—	—	20.3	37.52
	Std. dev.	0.124	0.012	0.09	0.016	0.009	1.133	—	—	—	—	1.688	2.579
	N obs.	13	13	13	13	13	13	0	0	0	0	13	13
1995 Near-surface measurements: spring													
1. Main channel	Mean	3.606	0.041	2.974	0.069	0.005	3.387	—	—	—	—	10.58	56.35
	Median	3.681	0.03	2.952	0.07	-0.01	3.532	—	—	—	—	11.07	53.82
	Minimum	2.954	-0.02	2.482	0.047	-0.01	2.691	—	—	—	—	6.57	33.56
	Maximum	3.9	0.073	3.405	0.084	0.01	3.691	—	—	—	—	13.05	87.28
	Std. dev.	0.264	0.024	0.275	0.011	0.001	0.363	—	—	—	—	2.594	16.52
	N obs.	13	13	13	13	13	8	0	0	0	0	8	8
2. Side channel	Mean	3.439	0.04	2.692	0.07	0.005	3.239	—	—	—	—	11.34	57.11
	Median	3.52	0.03	2.677	0.069	-0.01	3.256	—	—	—	—	12.15	54.71
	Minimum	2.949	-0.02	2.167	0.047	-0.01	2.336	—	—	—	—	4.262	24.72
	Maximum	3.884	0.094	3.3	0.106	-0.01	4.019	—	—	—	—	15.64	87.95
	Std. dev.	0.278	0.025	0.307	0.016	0	0.492	—	—	—	—	3.233	16.77
	N obs.	17	17	17	17	17	12	0	0	0	0	12	12
3. Backwater	Mean	2.799	0.048	1.852	0.074	0.005	2.513	—	—	—	—	11.23	49.1
	Median	2.991	0.038	2.174	0.071	-0.01	2.915	—	—	—	—	11.57	44.44
	Minimum	1.506	-0.02	-0.01	0.038	-0.01	0.133	—	—	—	—	4.862	23.83
	Maximum	3.681	0.123	2.935	0.147	0.01	3.496	—	—	—	—	17.55	89.93
	Std. dev.	0.647	0.026	0.898	0.026	88E-5	0.939	—	—	—	—	2.597	15.59
	N obs.	32	32	32	32	32	21	0	0	0	0	21	21
5. Impounded	Mean	3.305	0.048	2.616	0.061	0.005	3.471	—	—	—	—	11.98	50.94
	Median	3.394	0.047	2.652	0.056	-0.01	3.365	—	—	—	—	12.21	50.14
	Minimum	2.826	0.021	1.848	0.036	-0.01	3.016	—	—	—	—	6.02	28
	Maximum	3.743	0.078	3.235	0.092	-0.01	3.96	—	—	—	—	13.81	60.36
	Std. dev.	0.33	0.019	0.465	0.016	0	0.33	—	—	—	—	2.268	9.915
	N obs.	13	13	13	13	13	10	0	0	0	0	10	10

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1995 Near-surface measurements: spring													
6. Isolated	Mean	1.631	0.33	0.021	0.136	0.016	-0.05	—	—	—	—	85.22	7.092
	Median	1.475	0.232	-0.01	0.115	0.016	-0.05	—	—	—	—	85.22	7.092
	Minimum	1.277	0.044	-0.01	0.092	0.01	-0.05	—	—	—	—	85.22	7.092
	Maximum	2.097	0.693	0.067	0.206	0.021	-0.05	—	—	—	—	85.22	7.092
	Std. dev.	0.364	0.275	0.026	0.04	0.004	—	—	—	—	—	—	—
	N obs.	6	6	6	6	6	1	0	0	0	0	1	1
1995 Near-surface measurements: summer													
1. Main channel	Mean	2.306	0.09	1.233	0.149	0.061	7.979	—	—	—	—	12.03	51.64
	Median	2.371	0.073	1.345	0.156	0.063	7.979	—	—	—	—	12.03	51.64
	Minimum	1.946	0.03	-0.01	0.099	0.043	7.979	—	—	—	—	12.03	51.64
	Maximum	2.712	0.222	1.842	0.183	0.087	7.979	—	—	—	—	12.03	51.64
	Std. dev.	0.254	0.061	0.471	0.025	0.012	—	—	—	—	—	—	—
	N obs.	15	15	15	15	15	1	0	0	0	0	1	1
2. Side channel	Mean	2.306	0.05	1.278	0.154	0.07	7.421	—	—	—	—	11.91	50.05
	Median	2.37	0.043	1.426	0.157	0.068	7.387	—	—	—	—	11.93	51.18
	Minimum	1.71	-0.02	-0.01	0.091	0.058	6.927	—	—	—	—	11.26	44.61
	Maximum	2.816	0.129	1.627	0.189	0.088	7.756	—	—	—	—	12.36	53.29
	Std. dev.	0.332	0.029	0.418	0.025	0.009	0.325	—	—	—	—	0.412	3.674
	N obs.	15	15	15	15	15	5	0	0	0	0	5	5
3. Backwater	Mean	2.594	0.085	0.897	0.184	0.064	7.435	—	—	—	—	11.87	48.85
	Median	2.379	0.055	0.865	0.162	0.067	7.597	—	—	—	—	12	52.26
	Minimum	1.112	0.027	-0.01	0.125	0.014	6.22	—	—	—	—	10.81	37.05
	Maximum	10.56	0.402	1.611	0.357	0.104	7.789	—	—	—	—	12.4	54.13
	Std. dev.	1.583	0.075	0.541	0.055	0.017	0.47	—	—	—	—	0.582	6.055
	N obs.	32	32	32	32	32	10	0	0	0	0	10	10
5. Impounded	Mean	2.69	0.056	1.547	0.165	0.065	—	—	—	—	—	—	—
	Median	2.552	0.052	1.514	0.167	0.072	—	—	—	—	—	—	—
	Minimum	2.279	0.037	1.341	0.117	-0.01	—	—	—	—	—	—	—
	Maximum	4.421	0.092	1.91	0.203	0.094	—	—	—	—	—	—	—
	Std. dev.	0.509	0.016	0.159	0.025	0.023	—	—	—	—	—	—	—
	N obs.	15	15	15	15	15	0	0	0	0	0	0	0

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1995 Near-surface measurements: summer													
6. Isolated	Mean	2.886	0.637	0.313	1.271	0.686	4.214	—	—	—	—	101.2	4.941
	Median	1.89	0.118	-0.01	0.545	0.01	2.788	—	—	—	—	88.99	0.777
	Minimum	1.133	0.041	-0.01	0.063	-0.01	0.238	—	—	—	—	70.22	-0.01
	Maximum	5.781	2.322	0.969	4.17	3.19	11.91	—	—	—	—	152.7	18.11
	Std. dev.	1.835	0.89	0.478	1.512	1.166	3.878	—	—	—	—	32.66	6.996
	N obs.	6	6	6	6	7	7	0	0	0	0	7	7
1995 Near-surface measurements: fall													
1. Main channel	Mean	1.889	0.056	0.834	0.131	0.073	3.184	—	—	—	—	15.1	37.9
	Median	1.776	0.058	0.716	0.119	0.076	1.951	—	—	—	—	14.28	36.05
	Minimum	1.464	0.029	0.649	0.089	0.06	1.488	—	—	—	—	13.45	35.22
	Maximum	2.469	0.079	1.242	0.182	0.085	6.112	—	—	—	—	17.57	42.42
	Std. dev.	0.325	0.015	0.207	0.032	0.009	2.547	—	—	—	—	2.177	3.942
	N obs.	13	13	13	13	13	3	0	0	0	0	3	3
2. Side channel	Mean	1.894	0.061	0.861	0.137	0.07	5.365	—	—	—	—	13.79	34.1
	Median	1.777	0.06	0.777	0.133	0.069	5.365	—	—	—	—	13.79	34.1
	Minimum	1.416	0.031	0.595	0.09	0.048	5.365	—	—	—	—	13.79	34.1
	Maximum	2.552	0.089	1.27	0.177	0.098	5.365	—	—	—	—	13.79	34.1
	Std. dev.	0.39	0.015	0.266	0.026	0.014	—	—	—	—	—	—	—
	N obs.	15	15	15	15	15	1	0	0	0	0	1	1
3. Backwater	Mean	1.52	0.072	0.463	0.144	0.051	2.327	—	—	—	—	9.034	15.46
	Median	1.438	0.065	0.553	0.15	0.063	1.197	—	—	—	—	7.587	11.23
	Minimum	0.905	-0.02	-0.01	0.026	-0.01	0.832	—	—	—	—	6.279	9.391
	Maximum	2.28	0.356	0.883	0.334	0.098	5.252	—	—	—	—	13.5	28.04
	Std. dev.	0.336	0.058	0.267	0.063	0.031	2.013	—	—	—	—	3.144	8.529
	N obs.	35	35	35	35	35	4	0	0	0	0	4	4
5. Impounded	Mean	1.588	0.062	0.658	0.161	0.07	—	—	—	—	—	—	—
	Median	1.586	0.061	0.66	0.149	0.072	—	—	—	—	—	—	—
	Minimum	1.384	0.022	0.58	0.108	0.052	—	—	—	—	—	—	—
	Maximum	1.906	0.102	0.757	0.302	0.09	—	—	—	—	—	—	—
	Std. dev.	0.124	0.024	0.046	0.049	0.012	—	—	—	—	—	—	—
	N obs.	13	13	13	13	13	0	0	0	0	0	0	0

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1995 Near-surface measurements: fall													
6. Isolated	Mean	1.533	0.159	0.06	0.644	0.481	—	—	—	—	—	—	—
	Median	1.387	0.04	-0.01	0.198	0.069	—	—	—	—	—	—	—
	Minimum	1.031	-0.02	-0.01	0.071	-0.01	—	—	—	—	—	—	—
	Maximum	2.442	0.427	0.274	1.61	1.36	—	—	—	—	—	—	—
	Std. dev.	0.484	0.168	0.107	0.736	0.666	—	—	—	—	—	—	—
	N obs.	6	6	6	6	6	0	0	0	0	0	0	0
1996 Near-surface measurements: winter													
1. Main channel	Mean	2.299	0.337	1.591	0.084	0.06	—	—	—	—	—	—	—
	Median	2.275	0.312	1.555	0.082	0.061	—	—	—	—	—	—	—
	Minimum	2.118	0.268	1.425	0.07	0.034	—	—	—	—	—	—	—
	Maximum	2.747	0.689	2.116	0.114	0.087	—	—	—	—	—	—	—
	Std. dev.	0.156	0.108	0.167	0.012	0.014	—	—	—	—	—	—	—
	N obs.	13	13	13	13	13	0	0	0	0	0	0	0
2. Side channel	Mean	2.327	0.342	1.523	0.082	0.054	—	—	—	—	—	—	—
	Median	2.308	0.316	1.501	0.083	0.053	—	—	—	—	—	—	—
	Minimum	2.16	0.29	1.431	0.065	0.043	—	—	—	—	—	—	—
	Maximum	2.64	0.45	1.688	0.095	0.072	—	—	—	—	—	—	—
	Std. dev.	0.13	0.047	0.065	0.01	0.008	—	—	—	—	—	—	—
	N obs.	16	16	16	16	16	0	0	0	0	0	0	0
3. Backwater	Mean	2.449	0.643	1.263	0.183	0.05	—	—	—	—	—	—	—
	Median	2.36	0.471	1.472	0.087	0.05	—	—	—	—	—	—	—
	Minimum	2.003	0.275	-0.01	0.067	-0.01	—	—	—	—	—	—	—
	Maximum	4.853	1.932	2.169	1.161	0.077	—	—	—	—	—	—	—
	Std. dev.	0.557	0.466	0.561	0.287	0.021	—	—	—	—	—	—	—
	N obs.	24	24	24	24	24	0	0	0	0	0	0	0
5. Impounded	Mean	2.27	0.32	1.58	0.09	0.05	—	—	—	—	—	—	—
	Median	2.25	0.317	1.571	0.086	0.047	—	—	—	—	—	—	—
	Minimum	2.078	0.242	1.421	0.069	0.031	—	—	—	—	—	—	—
	Maximum	2.501	0.425	1.844	0.112	0.07	—	—	—	—	—	—	—
	Std. dev.	0.14	0.047	0.097	0.014	0.012	—	—	—	—	—	—	—
	N obs.	13	13	13	13	13	0	0	0	0	0	0	0

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1996 Near-surface measurements: spring													
1. Main channel	Mean	1.45	—	0.676	0.107	0.042	—	—	—	—	—	—	—
	Median	1.396	—	0.734	0.1	0.042	—	—	—	—	—	—	—
	Minimum	1.136	—	0.297	0.09	0.023	—	—	—	—	—	—	—
	Maximum	1.628	—	0.852	0.13	0.05	—	—	—	—	—	—	—
	Std. dev.	0.142	—	0.162	0.014	0.007	—	—	—	—	—	—	—
	N obs.	14	0	14	14	14	0	0	0	0	0	0	0
2. Side channel	Mean	1.446	—	0.628	0.104	0.04	—	—	—	—	—	—	—
	Median	1.478	—	0.566	0.103	0.041	—	—	—	—	—	—	—
	Minimum	0.999	—	0.347	0.082	0.029	—	—	—	—	—	—	—
	Maximum	1.7	—	1.322	0.126	0.045	—	—	—	—	—	—	—
	Std. dev.	0.176	—	0.224	0.011	0.004	—	—	—	—	—	—	—
	N obs.	17	0	17	17	17	0	0	0	0	0	0	0
3. Backwater	Mean	1.456	—	0.598	0.088	0.039	—	—	—	—	—	—	—
	Median	1.341	—	0.531	0.084	0.039	—	—	—	—	—	—	—
	Minimum	0.832	—	-0.01	0.051	0.025	—	—	—	—	—	—	—
	Maximum	3.013	—	2.303	0.119	0.044	—	—	—	—	—	—	—
	Std. dev.	0.452	—	0.487	0.017	0.004	—	—	—	—	—	—	—
	N obs.	33	0	33	33	33	0	0	0	0	0	0	0
5. Impounded	Mean	1.459	—	0.515	0.102	0.041	—	—	—	—	—	—	—
	Median	1.365	—	0.477	0.103	0.041	—	—	—	—	—	—	—
	Minimum	1.205	—	0.352	0.086	0.029	—	—	—	—	—	—	—
	Maximum	2.017	—	0.852	0.114	0.047	—	—	—	—	—	—	—
	Std. dev.	0.266	—	0.143	0.009	0.005	—	—	—	—	—	—	—
	N obs.	13	0	13	13	13	0	0	0	0	0	0	0
6. Isolated	Mean	1.538	—	0.121	—	0.037	—	—	—	—	—	—	—
	Median	1.248	—	0.087	—	0.037	—	—	—	—	—	—	—
	Minimum	0.97	—	-0.01	—	0.031	—	—	—	—	—	—	—
	Maximum	3.476	—	0.41	—	0.04	—	—	—	—	—	—	—
	Std. dev.	0.873	—	0.149	—	0.003	—	—	—	—	—	—	—
	N obs.	7	0	7	0	7	0	0	0	0	0	0	0

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1996 Near-surface measurements: summer													
1. Main channel	Mean	1.853	0.045	1.085	0.126	0.044	5.201	—	—	—	—	13.05	36.46
	Median	1.801	0.038	1.118	0.106	0.041	5.274	—	—	—	—	12.13	35.6
	Minimum	1.36	-0.02	0.729	0.082	0.012	4.462	—	—	—	—	11.54	34.44
	Maximum	3.623	0.1	1.383	0.302	0.071	5.712	—	—	—	—	17.26	39.36
	Std. dev.	0.564	0.028	0.223	0.068	0.018	0.491	—	—	—	—	2.115	1.992
	N obs.	13	13	13	9	13	6	0	0	0	0	6	6
2. Side channel	Mean	1.741	0.051	1.062	0.133	0.042	5.399	—	—	—	—	12.35	34.63
	Median	1.713	0.048	1.112	0.113	0.038	5.665	—	—	—	—	12.06	35.28
	Minimum	1.473	-0.02	0.826	0.09	0.014	4.373	—	—	—	—	11.7	31.86
	Maximum	2.134	0.12	1.258	0.246	0.079	6.232	—	—	—	—	14.27	35.67
	Std. dev.	0.176	0.031	0.125	0.045	0.021	0.754	—	—	—	—	0.928	1.344
	N obs.	17	17	17	10	17	7	0	0	0	0	7	7
3. Backwater	Mean	1.608	0.055	0.745	0.194	0.033	4.904	—	—	—	—	10.29	27.16
	Median	1.68	0.05	0.87	0.122	0.025	5.348	—	—	—	—	11.92	34.27
	Minimum	0.689	-0.02	-0.01	0.076	-0.01	2.015	—	—	—	—	0.623	1.69
	Maximum	2.45	0.137	1.39	1.075	0.077	6.266	—	—	—	—	14.5	42.54
	Std. dev.	0.39	0.026	0.487	0.232	0.023	1.273	—	—	—	—	3.806	12.44
	N obs.	32	32	32	29	32	25	0	0	0	0	25	25
5. Impounded	Mean	1.614	0.032	0.911	0.114	0.035	5.591	—	—	—	—	11.78	35.25
	Median	1.586	0.026	0.881	0.118	0.03	5.552	—	—	—	—	11.75	34.81
	Minimum	1.372	-0.02	0.617	0.098	0.016	5.552	—	—	—	—	11.75	34.81
	Maximum	2.416	0.066	1.335	0.125	0.076	5.63	—	—	—	—	11.81	35.69
	Std. dev.	0.268	0.017	0.171	0.011	0.018	0.056	—	—	—	—	0.043	0.618
	N obs.	14	14	14	5	14	2	0	0	0	0	2	2
6. Isolated	Mean	2.76	0.045	0.005	0.291	0.074	—	—	—	—	—	—	—
	Median	2.77	0.029	-0.01	0.254	-0.01	—	—	—	—	—	—	—
	Minimum	0.764	0.021	-0.01	0.041	-0.01	—	—	—	—	—	—	—
	Maximum	5.564	0.104	-0.01	0.459	0.323	—	—	—	—	—	—	—
	Std. dev.	1.83	0.034	0	0.175	0.14	—	—	—	—	—	—	—
	N obs.	5	5	5	5	5	0	0	0	0	0	0	0

Table F-2. Continued.

Sampling stratum	Statistic	Total nitrogen (N mg/L)	Ammonium (N mg/L)	Nitrate–nitrite (N mg/L)	Total phosphorus (P mg/L)	Soluble reactive P (P mg/L)	Silica (Si mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
1996 Near-surface measurements: fall													
1. Main channel	Mean	1.299	0.02	0.363	0.272	0.006	3.873	—	—	—	—	13.02	19.22
	Median	1.285	-0.02	0.447	0.213	-0.01	3.873	—	—	—	—	13.02	19.22
	Minimum	1.125	-0.02	-0.01	0.091	-0.01	3.873	—	—	—	—	13.02	19.22
	Maximum	1.618	0.082	0.582	0.958	0.013	3.873	—	—	—	—	13.02	19.22
	Std. dev.	0.126	0.022	0.163	0.224	0.002	—	—	—	—	—	—	—
	N obs.	14	14	14	12	14	1	0	0	0	0	1	1
2. Side channel	Mean	1.259	0.014	0.238	0.248	0.005	—	—	—	—	—	—	—
	Median	1.26	-0.02	0.265	0.213	-0.01	—	—	—	—	—	—	—
	Minimum	0.972	-0.02	-0.01	0.117	-0.01	—	—	—	—	—	—	—
	Maximum	1.577	0.037	0.535	0.754	-0.01	—	—	—	—	—	—	—
	Std. dev.	0.151	0.008	0.176	0.157	0	—	—	—	—	—	—	—
	N obs.	17	17	17	16	17	0	0	0	0	0	0	0
3. Backwater	Mean	1.123	0.015	0.155	0.292	0.005	—	—	—	—	—	—	—
	Median	1.159	-0.02	0.116	0.202	-0.01	—	—	—	—	—	—	—
	Minimum	0.562	-0.02	-0.01	0.037	-0.01	—	—	—	—	—	—	—
	Maximum	1.51	0.036	0.472	1.022	0.012	—	—	—	—	—	—	—
	Std. dev.	0.209	0.008	0.159	0.267	0.002	—	—	—	—	—	—	—
	N obs.	35	35	35	23	35	0	0	0	0	0	0	0
5. Impounded	Mean	1.24	0.013	0.193	0.387	0.005	—	—	—	—	—	—	—
	Median	1.238	-0.02	0.191	0.212	-0.01	—	—	—	—	—	—	—
	Minimum	1.118	-0.02	-0.01	0.119	-0.01	—	—	—	—	—	—	—
	Maximum	1.355	0.029	0.497	1.184	-0.01	—	—	—	—	—	—	—
	Std. dev.	0.076	0.006	0.173	0.372	0	—	—	—	—	—	—	—
	N obs.	14	14	14	13	14	0	0	0	0	0	0	0
6. Isolated	Mean	1.249	0.01	0.005	0.703	0.421	—	—	—	—	—	—	—
	Median	1.194	-0.02	-0.01	0.184	0.019	—	—	—	—	—	—	—
	Minimum	1.115	-0.02	-0.01	0.168	-0.01	—	—	—	—	—	—	—
	Maximum	1.448	-0.02	-0.01	2.249	1.778	—	—	—	—	—	—	—
	Std. dev.	0.131	0	0	1.031	0.769	—	—	—	—	—	—	—
	N obs.	5	5	5	4	5	0	0	0	0	0	0	0

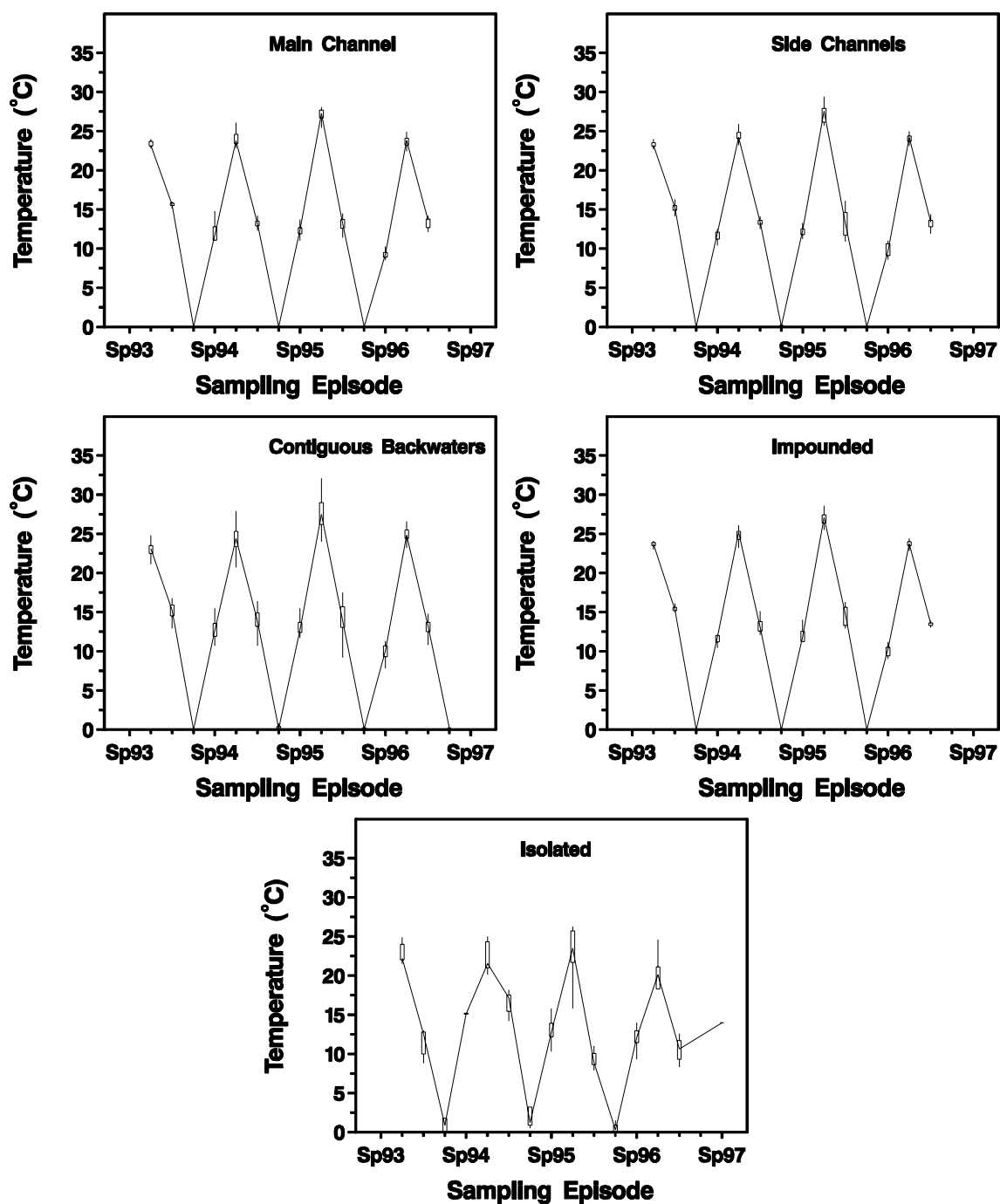


Figure F-1. Water temperature (°C) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

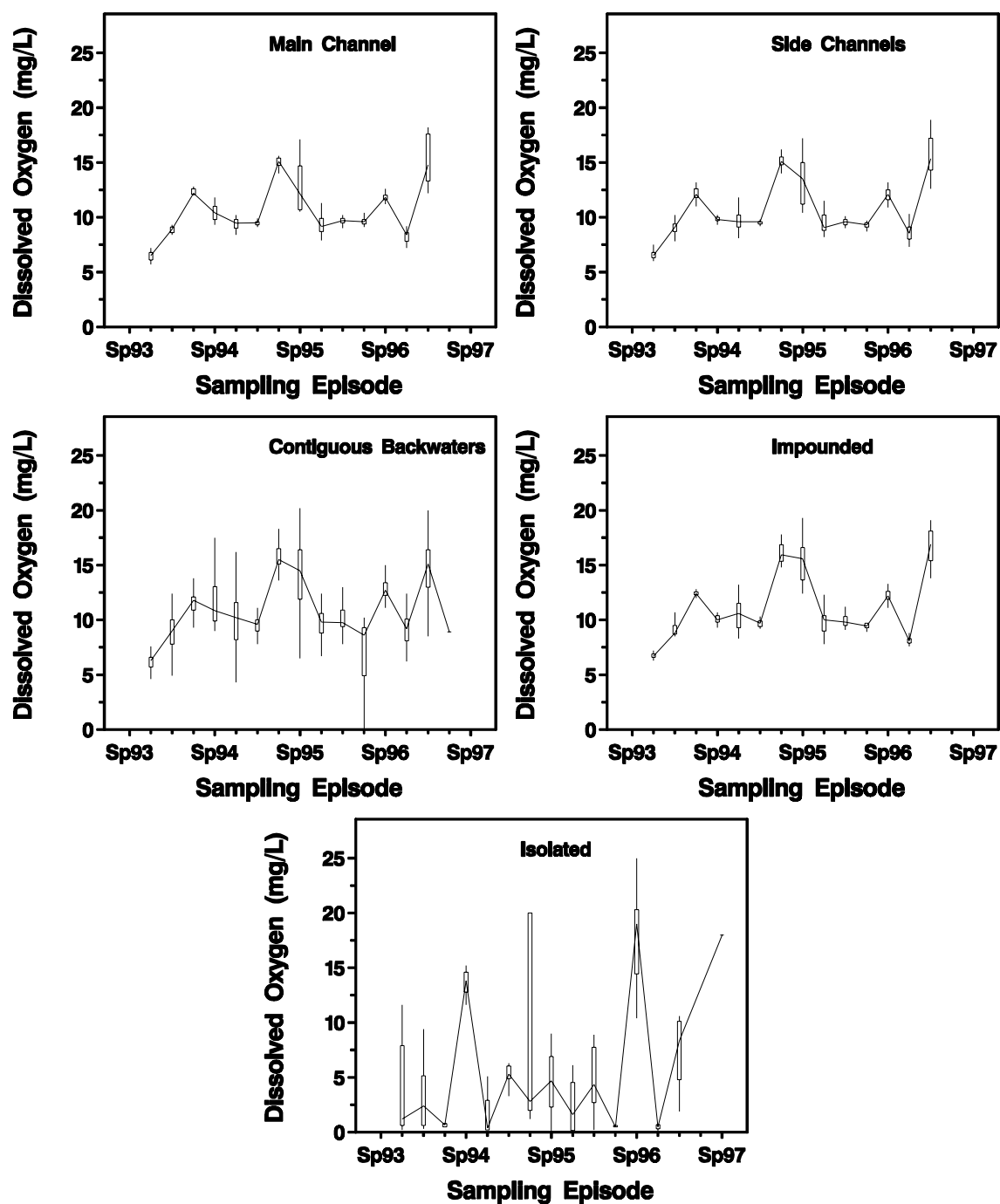


Figure F-2. Dissolved oxygen (mg/L) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

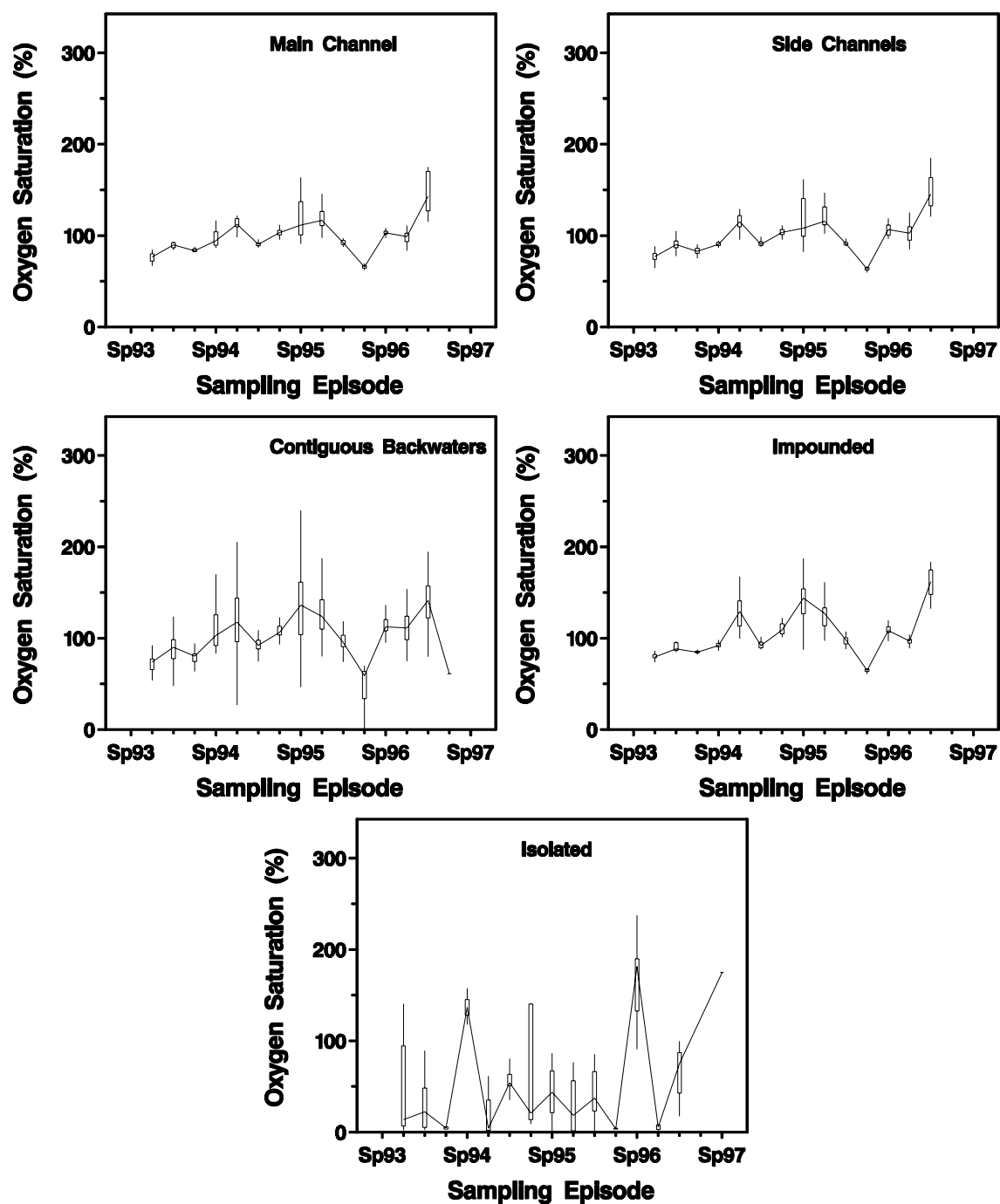


Figure F-3. Dissolved oxygen saturation (%) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

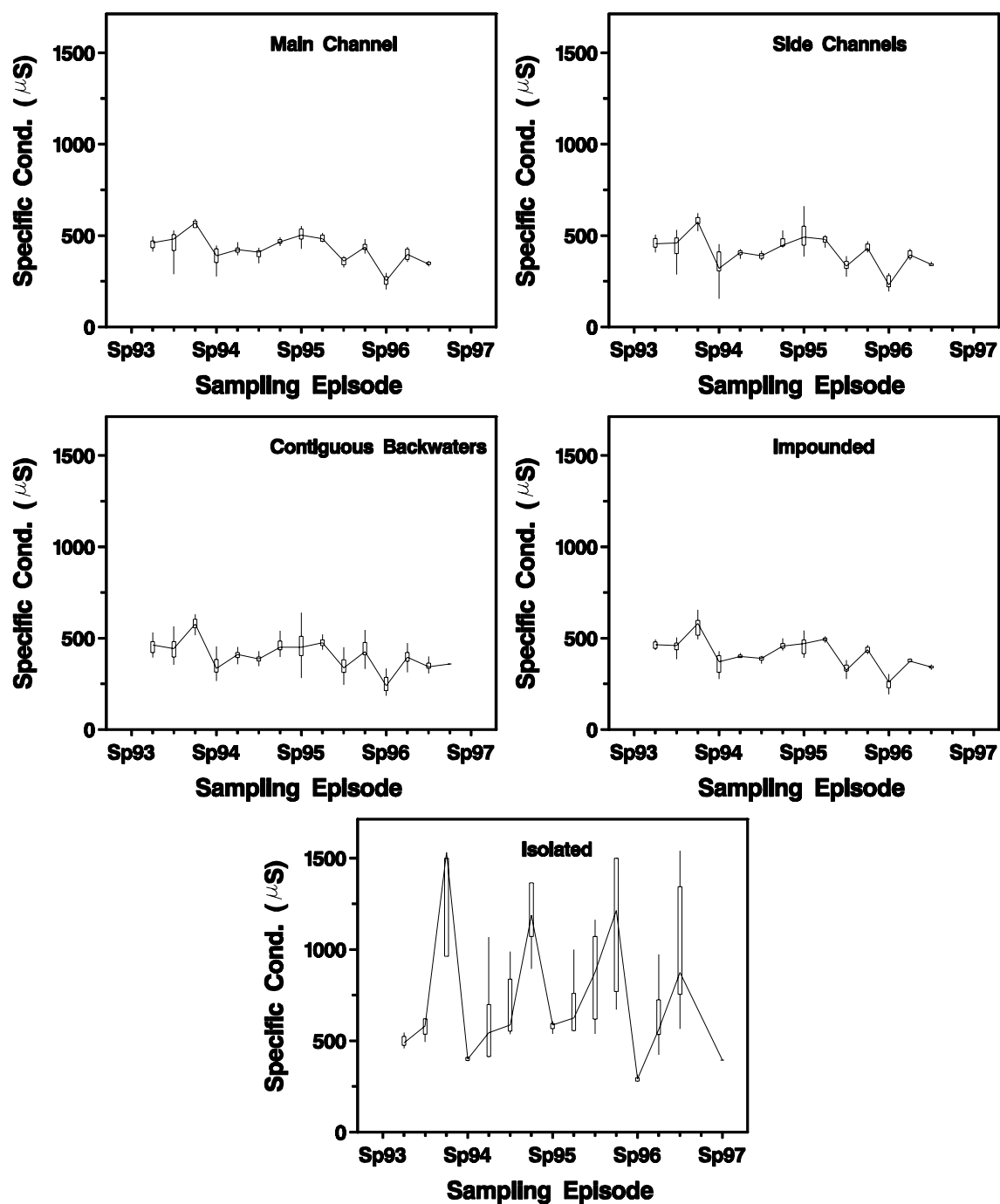


Figure F-4. Specific conductivity (µS) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

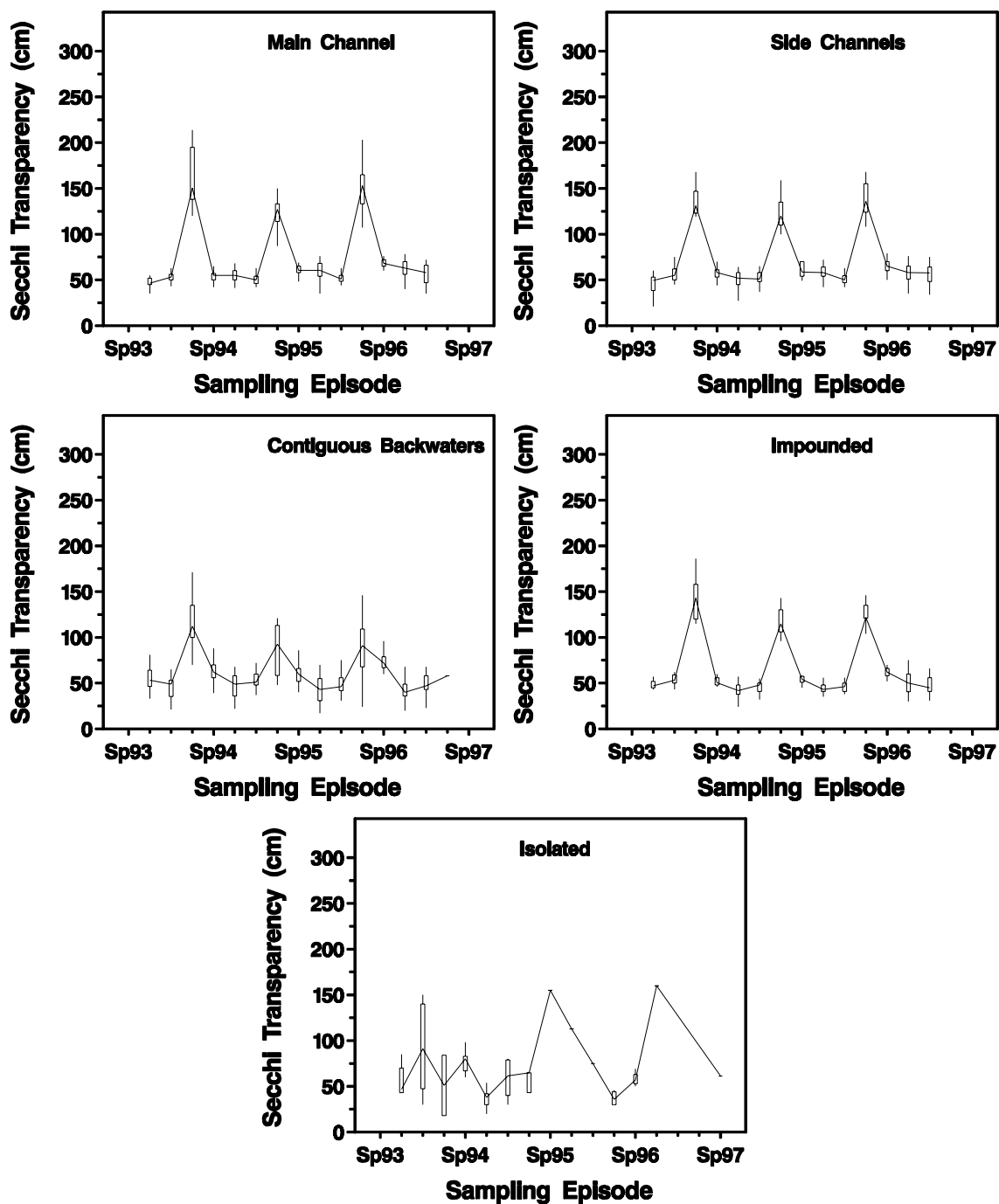


Figure F-5. Secchi transparency (cm) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

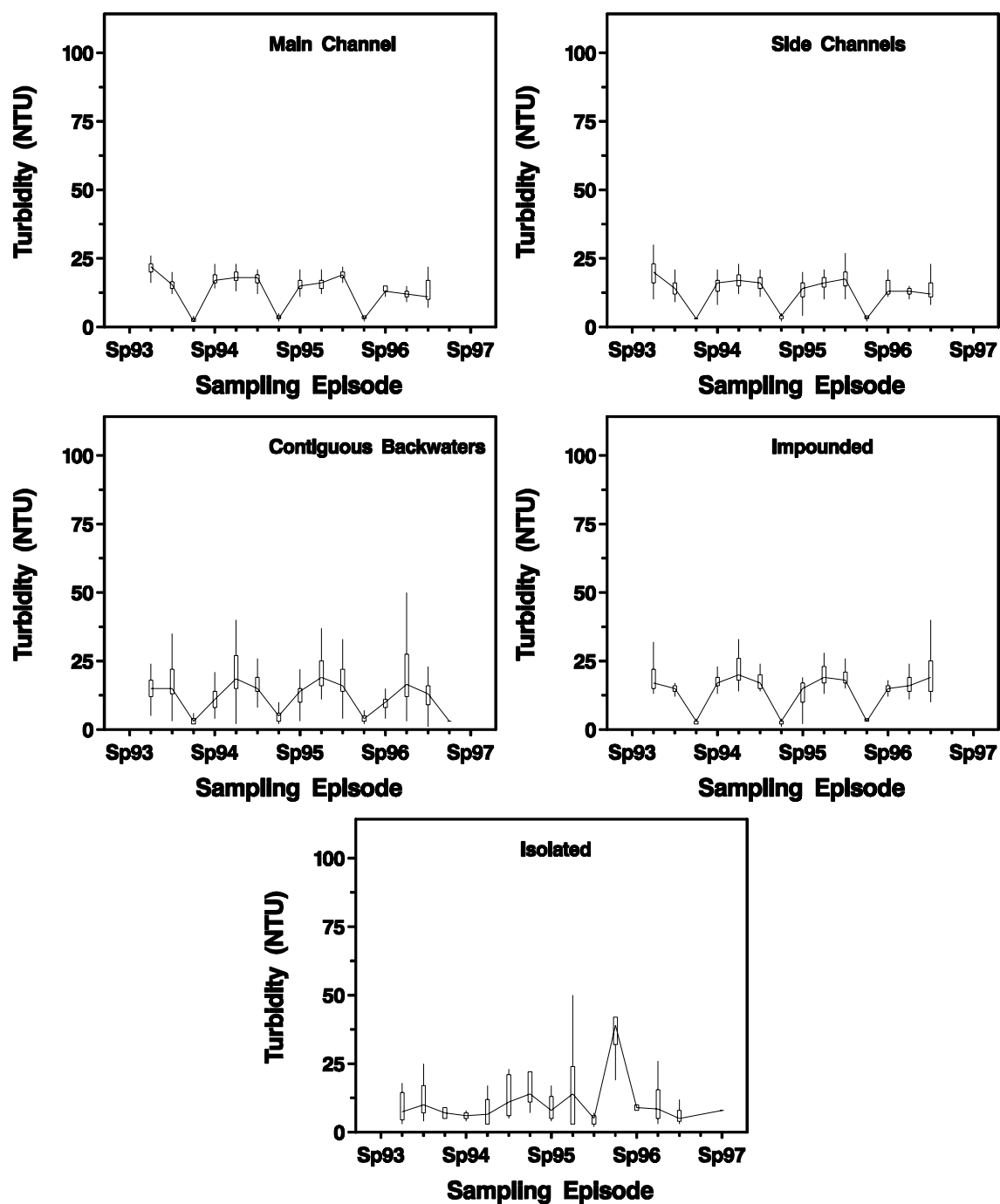


Figure F-6. Turbidity (NTU) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

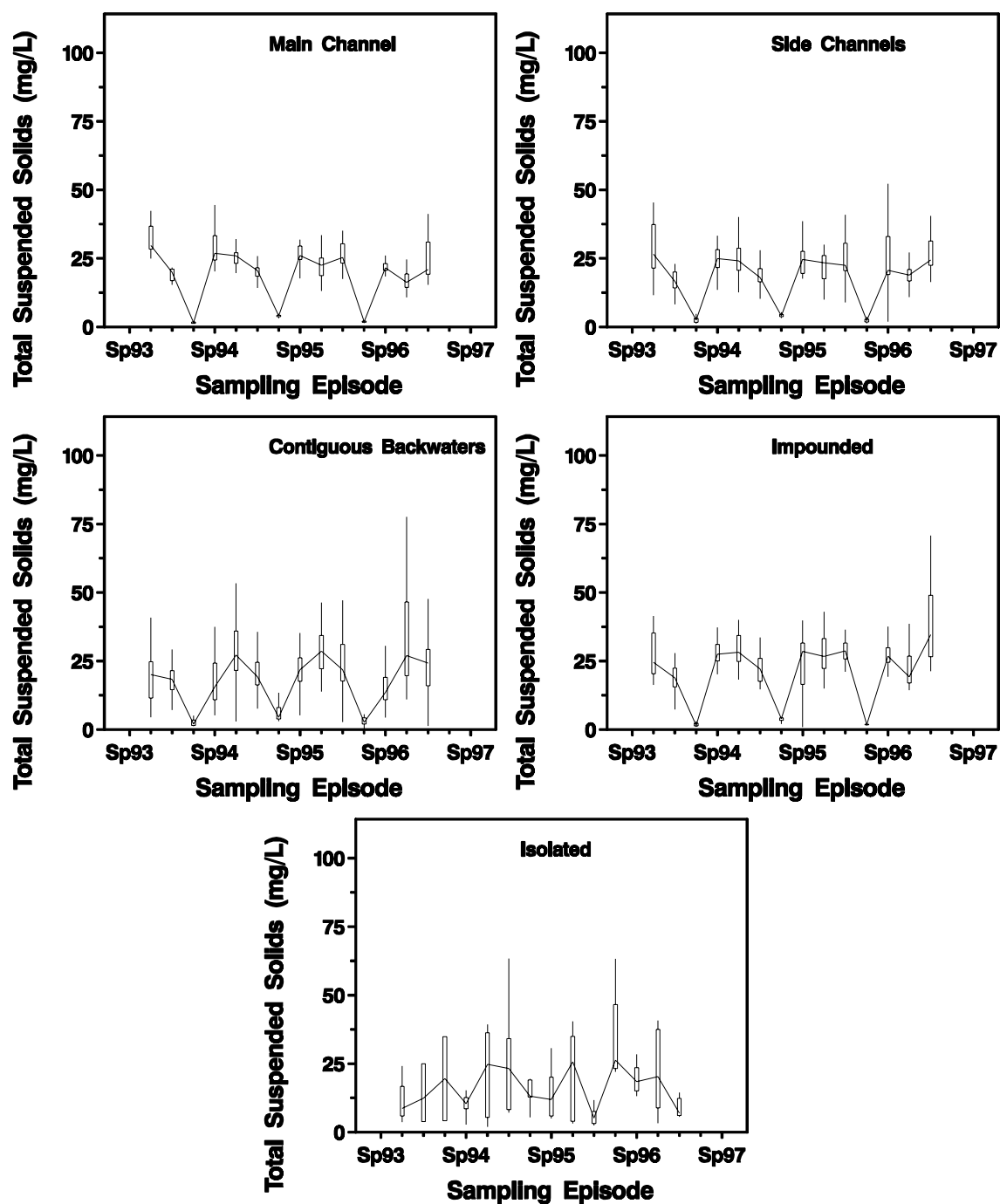


Figure F-7. Total suspended solids (mg/L) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

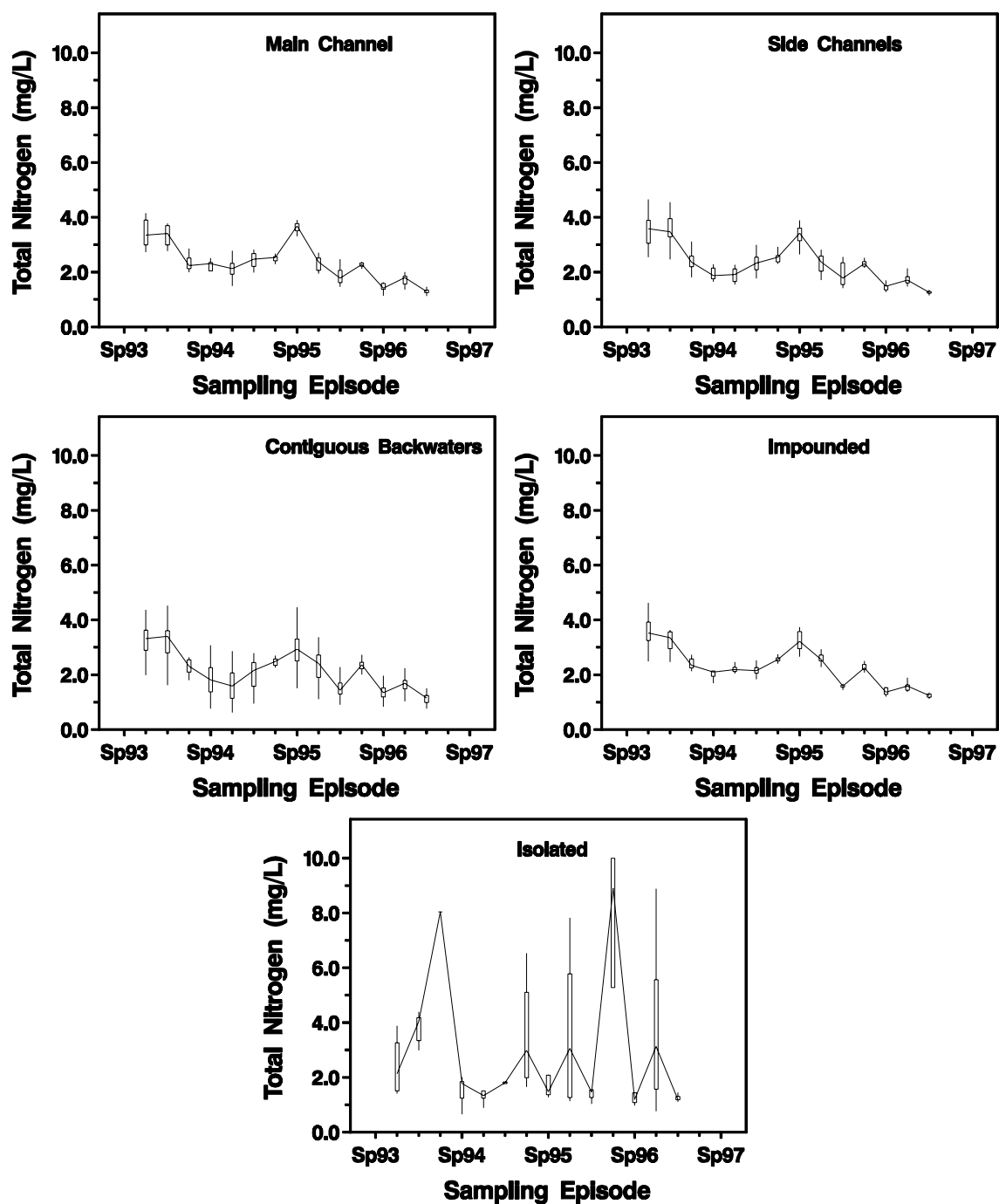


Figure F-8. Total nitrogen (mg/L) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

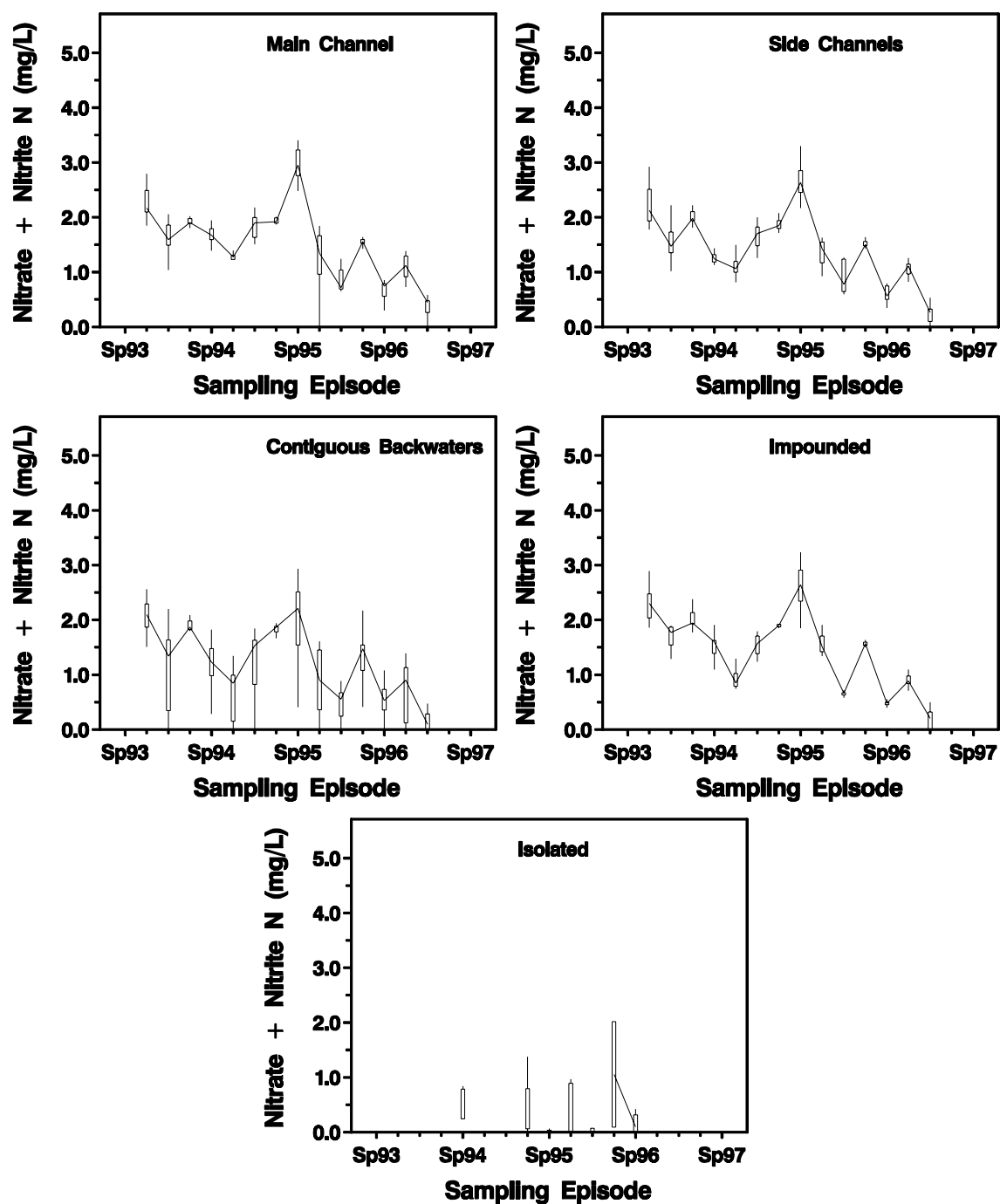


Figure F-9. Nitrate–nitrite nitrogen (mg/L) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

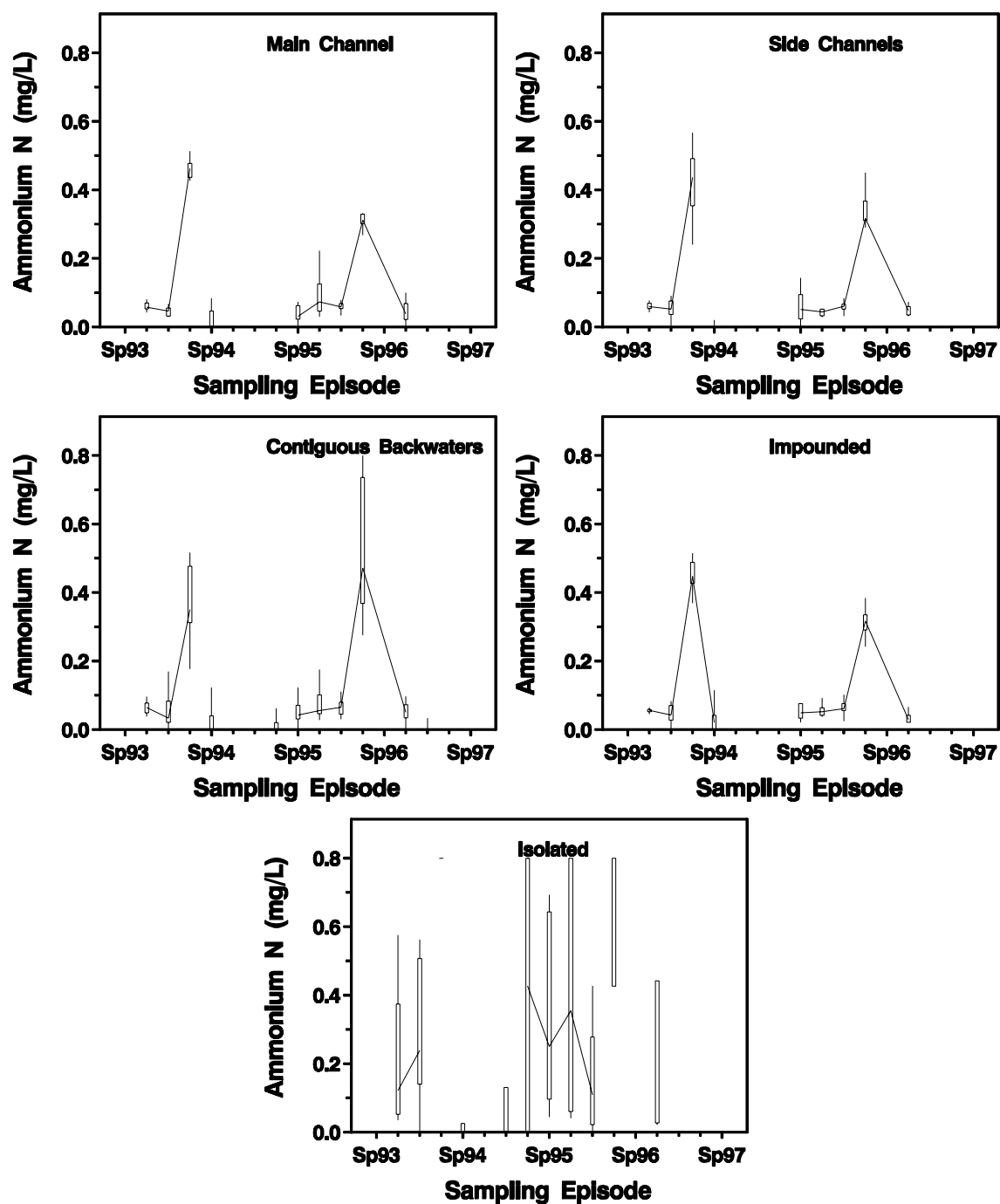


Figure F-10. Ammonium nitrogen (mg/L) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

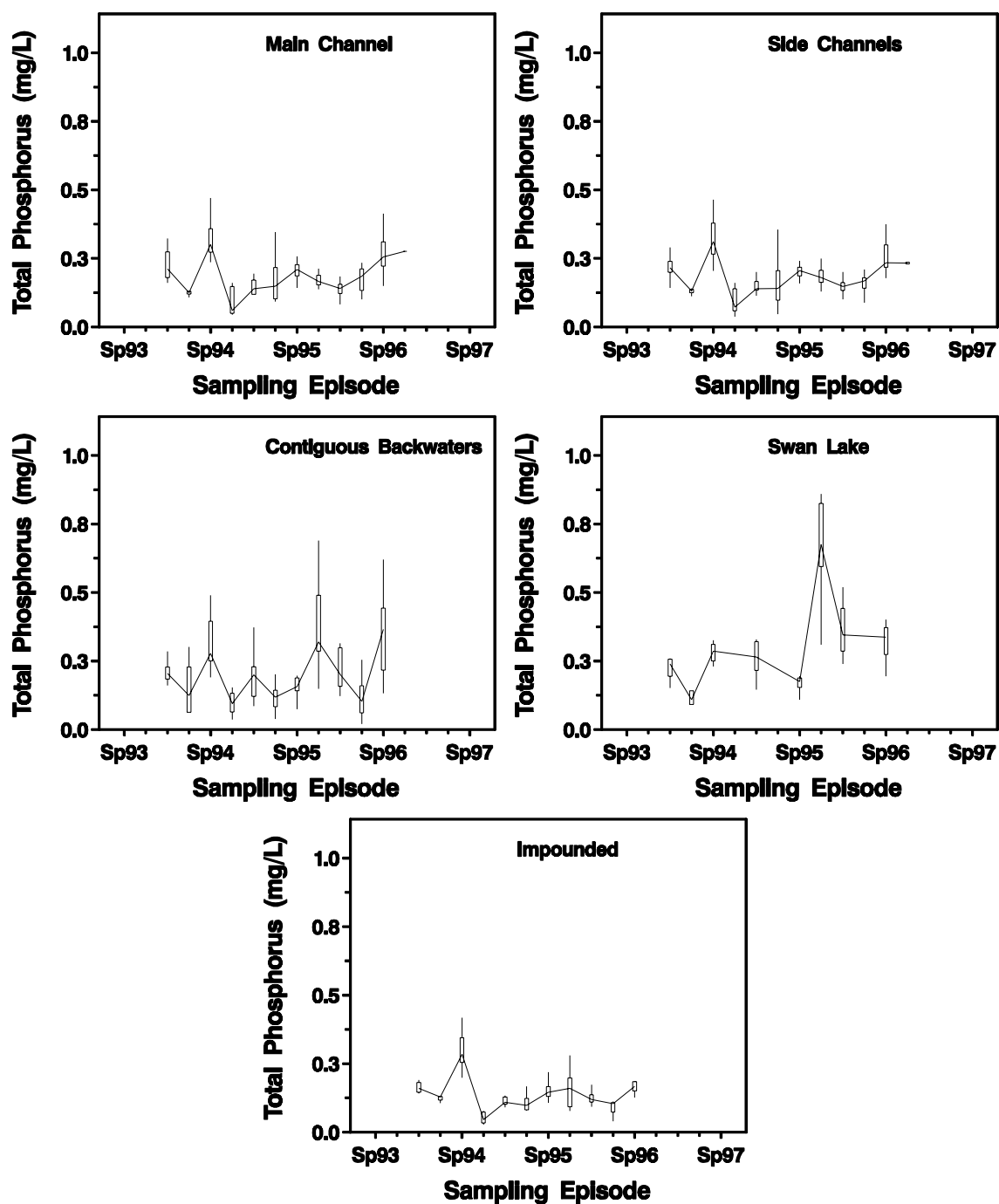


Figure F-11. Total phosphorus (mg/L) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

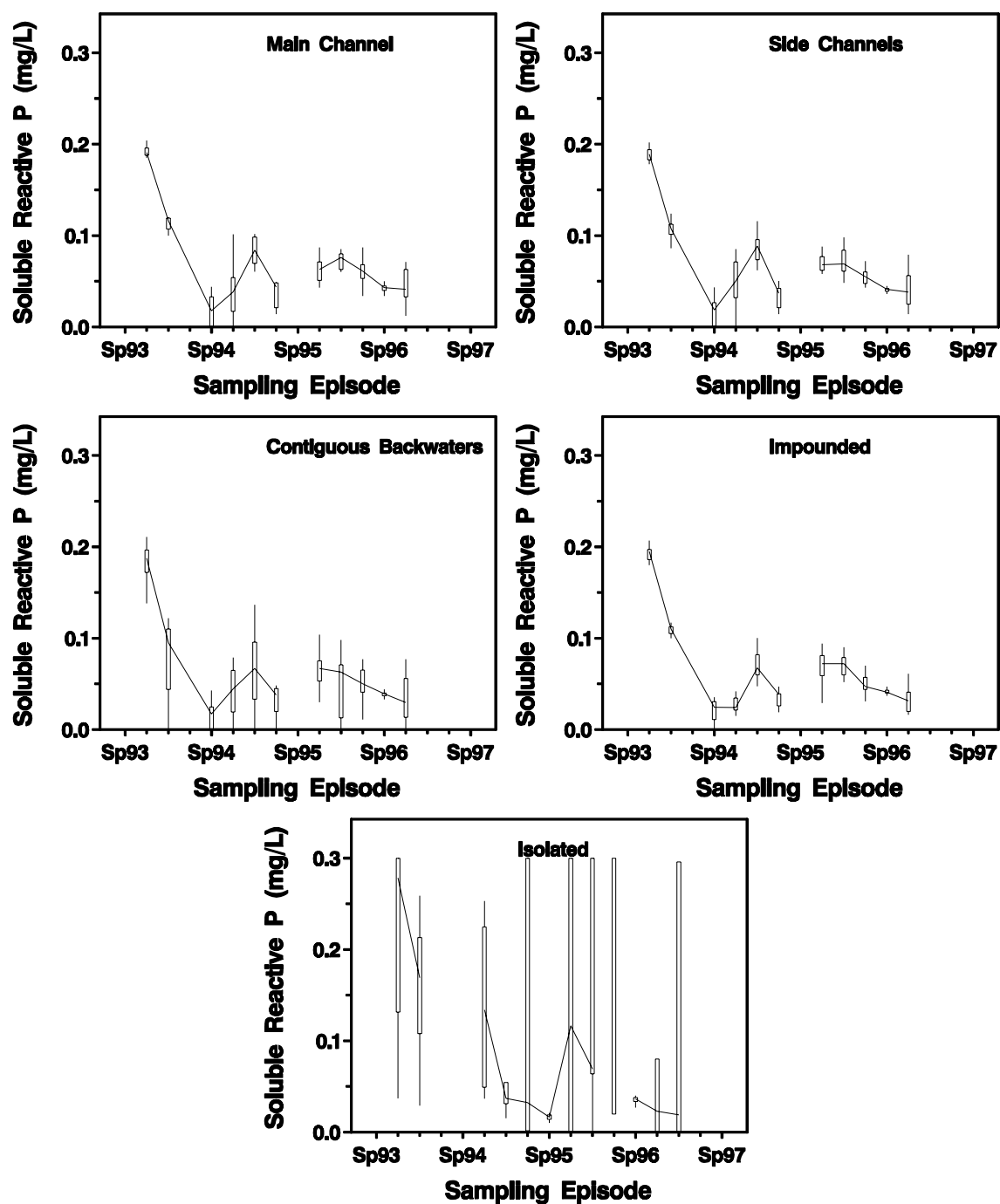


Figure F-12. Soluble reactive phosphorus (mg/L) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

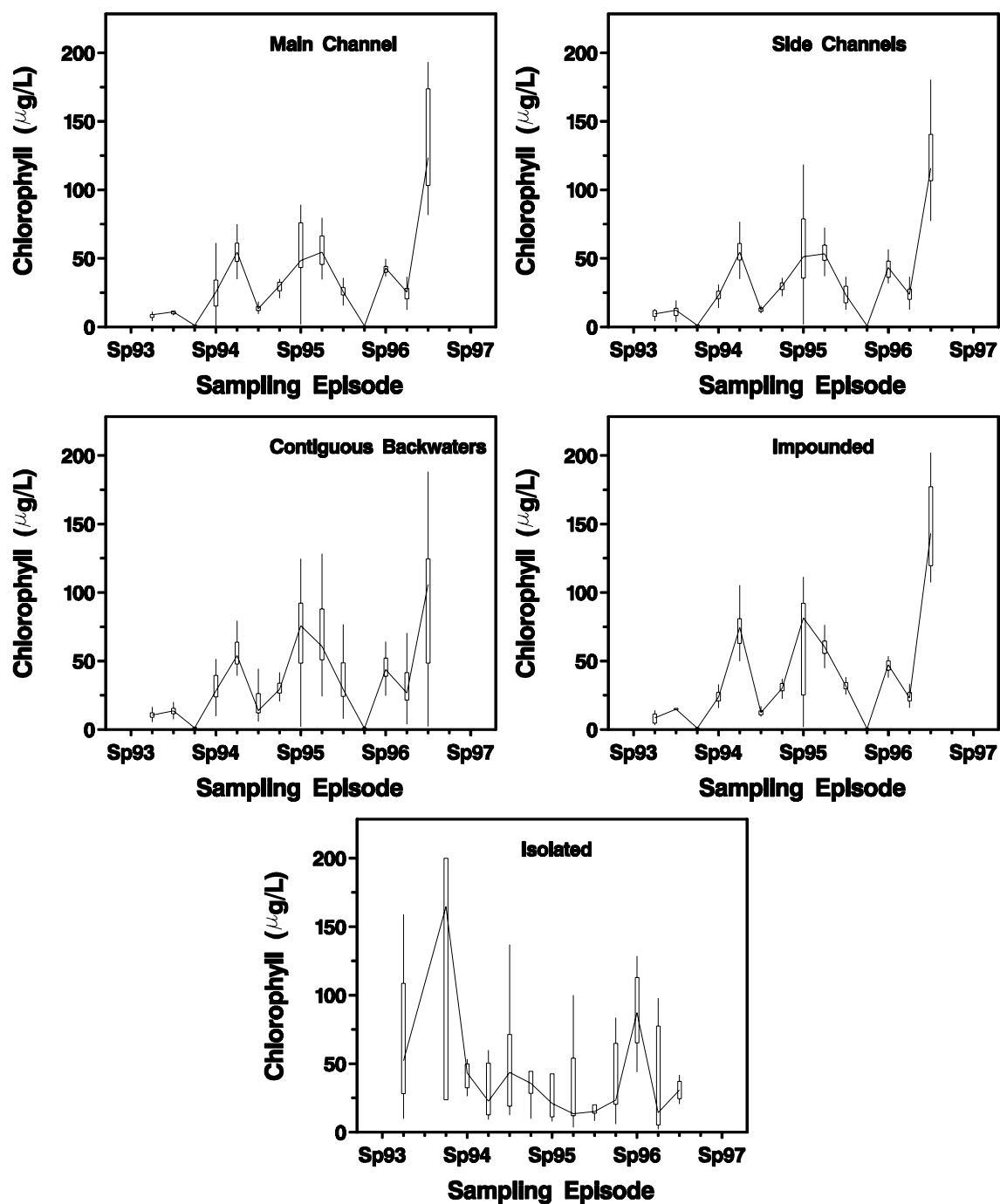


Figure F-13. Fluorometric chlorophyll *a* ($\mu\text{g/L}$) in stratified random sampling episodes from spring 1993 (Sp93) through fall 1996. Each sampling stratum is plotted separately. A solid line connects the medians of each episode, the 90th and 10th percentiles of the data are shown by the upper and lower extent of the box, and vertical lines extend to the maximum and minimum values (or to the limits of the plotting axis).

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13. ABSTRACT (Maximum 200 words) Since 1988, the Long Term Resource Monitoring Program (LTRMP) staff have performed basic limnological field measurements in the Upper Mississippi River System. The period of this report (1993–96) includes a major revision of the LTRMP sampling design in 1993 that added randomization, broader spatial coverage, and increased monitoring of tributaries and locations that allow monitoring of material transport. Personnel from the LTRMP Onalaska (Wisconsin) Field Station made about 1,300 visits to fixed limnological sampling sites and 2,100 visits to stratified random sites in the vicinity of Navigation Pool 8 from 1993 through 1996. An extended, late-season flood in summer 1993 coincided with some of the highest nutrient and lowest dissolved oxygen (DO) concentrations recorded during the report period. Decreases in nutrient concentrations (particularly nitrogen) and increases in water clarity occurred over the 4-year period. Midday DO concentrations were above 5 mg/L throughout most of the year and across most of Pool 8, with localized exceptions during periods of snow cover. Pool 8 and its watershed are a net source of sediment to the Mississippi River; main channel suspended solids concentrations were greater downstream than upstream, and concentrations in the tributaries were typically higher than in the main channel. Strong seasonal patterns were evident for temperature, DO, Secchi transparency, turbidity, total and volatile suspended solids, silicate, chlorophyll <i>a</i> , and total phosphorus. Spatial variability (among strata) of most measurements generally increased during lower discharge. Within the individual strata, the pattern of variability could be generalized as follows: isolated backwater > contiguous backwater > impounded ≥ side channel ≥ main channel.			
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The Long Term Resource Monitoring Program (LTRMP) for the Upper Mississippi River System was authorized under the Water Resources Development Act of 1986 as an element of the Environmental Management Program. The mission of the LTRMP is to provide river managers with information for maintaining the Upper Mississippi River System as a sustainable large river ecosystem given its multiple-use character. The LTRMP is a cooperative effort by the U.S. Geological Survey, the U.S. Army Corps of Engineers, and the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin.

